AERO DIGEST

INCLUDING AVIATION ENGINEERING

DECEMBER 1954

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PLASTICS IN AIRCRAFT

PROFILE: VON KARMAN OF THE JET AGE

DESIGN ANALYSIS: CURTISS-WRIGHT J65

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"Fleet Fighters"

Potent Chance Vought F7U-3 Cutlasses stand poised on the flight line, ready for delivery to fighter squadrons of the U. S. Fleet. Outstanding examples of Naval Aviation's new hard-hitting strength, these swift, powerful aircraft are designed to serve as interceptors, fighters or attack planes.

Chance Vought Aircraft INCORPORATED

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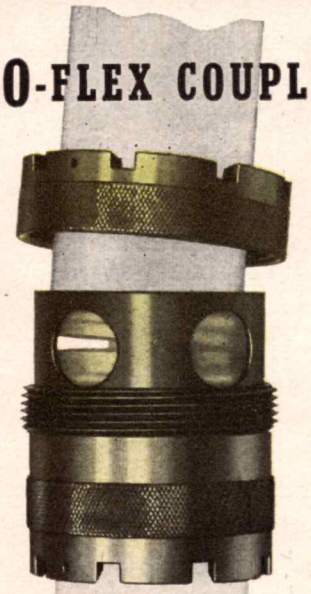
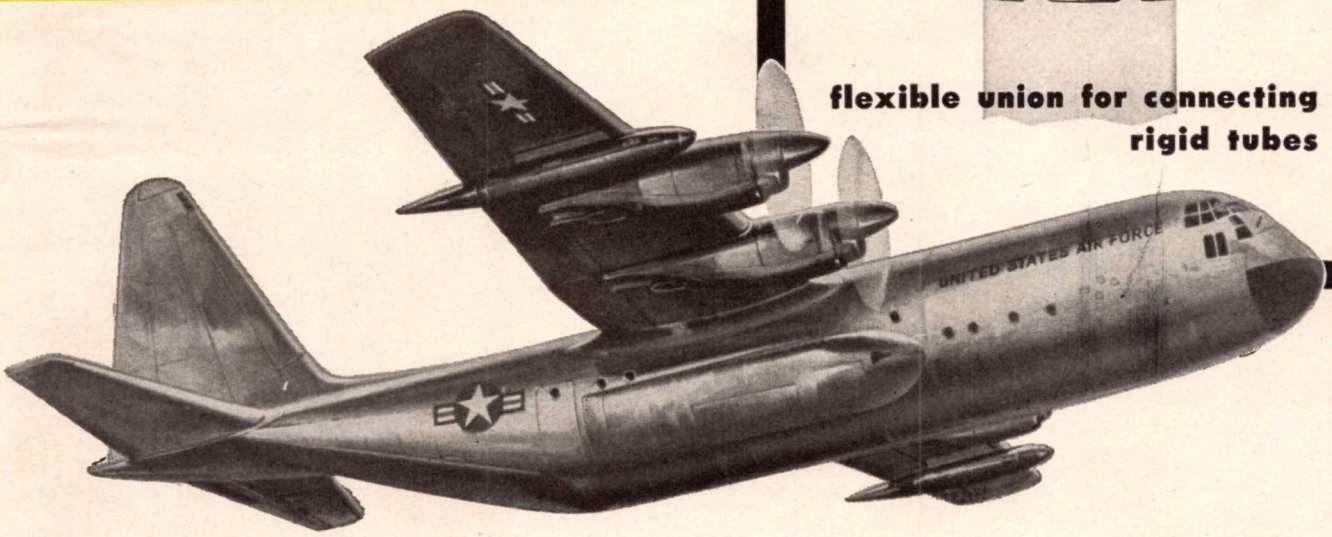
WIGGINS COUPLINGS SAVE 88 POUNDS ON LOCKHEED C-130

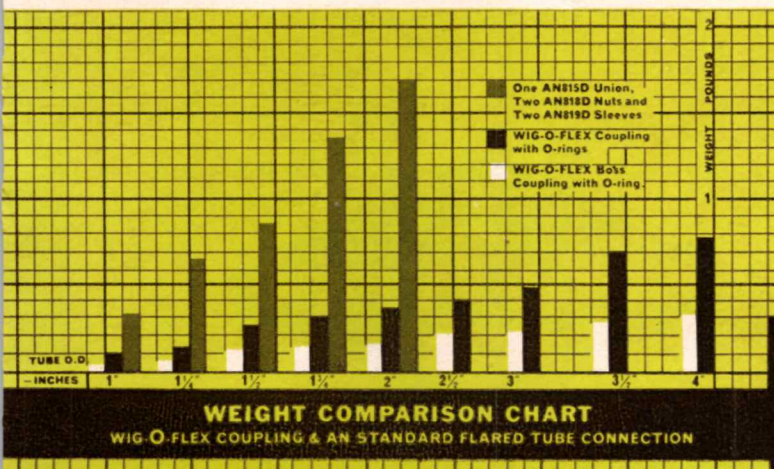
America's first turbo-prop transport—the Lockheed C-130—is 88 pounds lighter because WIG-O-FLEX Couplings replaced standard AN connections and cut hose. WIG-O-FLEX Couplings weigh 1/5 as much as the standard AN connections they can replace. (See Weight Chart for exact comparisons.)

WIG-O-FLEX COUPLING



flexible union for connecting rigid tubes





WEIGHT COMPARISON CHART
WIG-O-FLEX COUPLING & AN STANDARD FLARED TUBE CONNECTION

PROVED SUPERIOR FOR FUEL, OIL, AIR

- Withstands more than 1000 psi burst pressure.
- Accommodates 4° tube flexure.
- Installs locally, 80% lighter.
- Temperature range —65°F to +250°F.

SIZES: 1", 1¼", 1½", 1¾", 2", 2½", 3", 3½", 4"

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WRITE FOR FURTHER INFORMATION

The principle of electrothermal de-icing was developed by the National Research Council of Canada. The difficult propeller application was solved through the pioneering teamwork of Goodyear and Hamilton Standard of Windsor Locks, Connecticut. *Goodyear—a great name to work with TO GET RESULTS!*

Ten years ago, Hamilton Standard and Goodyear joined forces to do battle with ice—long a bitter enemy of the aircraft propeller.

It was pioneering effort which overcame technical difficulties that for years had stumped every aeronautical engineer who had sought a foolproof method for de-icing the whirling blades.

Out of this teamwork, the blade Iceguard was born—a new electrothermal system utilizing thin plies of electrically conductive rubber, power-fed by fatigue-resistant braided wire leads from a unique "pigtail" power connection.

THIN, the Iceguard conformed readily to blade contours — maintained the aerodynamic contour of the propeller. TOUGH, the homogeneous structure of the conductive rubber resisted rain and erosion—increased life of the de-icing equipment. EXTREMELY EFFICIENT, the Iceguard proved to be the most nearly perfect sheet-type heater because the thermal gradient across the heater is minimized.

And above all, RELIABLE. Today, as a result of the continued design and test work by Hamilton Standard, Goodyear and the help of the National Research Council of Canada, these famous propellers equipped *with Iceguards have logged 20 billion blade air miles and 65 million blade flying hours in actual service!*

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Iceguard—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

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Division of UNITED AIRCRAFT CORPORATION

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AERO DIGEST
INCLUDING AVIATION ENGINEERING

VOLUME 69 . . NUMBER 6 . . DECEMBER 1954

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The Effect of Airframe Flexure on Control Cable Tension

THIS is the first in a series of discussions of the many factors affecting control cable tension, and deals primarily with the increasing problems caused by airframe flexure. Future articles will deal with temperature, uniform tension, cable friction and unstable flight conditions.

While the problem of maintaining constant rigged tension is more apparent on larger aircraft, it is also present in all types of planes.

If it were practical to route cable systems directly along the neutral axis of the wing or fuselage, deflection problems would be minimized. However, competition with other lines, fuel tanks, equipment, and the many design problems generally make it impossible to truly locate the cable system along the neutral axis of its run.

Controlling Cable Tension

One of the principal purposes of installing cable tension regulators is to compensate for the relative change in the length of cable systems where it is impractical to route them along the neutral axis.

Pacific Cable Tension Regulators automatically compensate for normal airframe deflections, and thus provide greater flexibility in cable system design. As the name implies, this is a regulating mechanism, installed in any of several ways in a control cable system. Pacific Regulators are entirely mechanical in operation and need no hydraulics or electrical power. They require no maintenance between major airframe overhauls and are so designed that cable is taken up or let out equally in both sides of the system, under all flight conditions, thus resulting in the same phase condition at both ends of the system at all times.

For further details, write your nearest Pacific Scientific office for a free copy of the new *Aero News* with a more detailed discussion of this problem!

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Pacific CABLE TENSION REGULATORS give maximum

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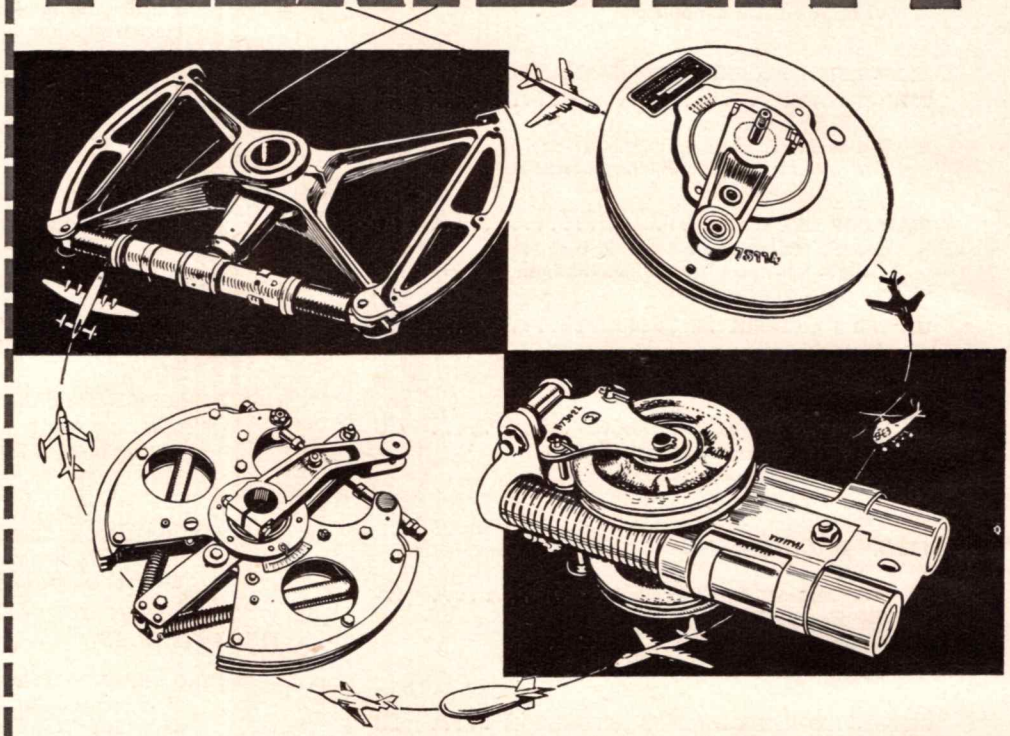

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FLEXIBLE INSTALLATION – the basic design used in Pacific Regulators is so flexible that it can be designed into any cable system or even adapted to existing installations. Pacific Regulators are available as built-in components of quadrants, sectors and cable drums. They're easy to install...entirely mechanical in operation...and in hundreds of installations Pacific Regulators have provided years of service with no maintenance required between major airframe overhauls.

Write for additional details or call your nearest Pacific Scientific Field Engineer.

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AERO NEWS DIGEST

CONVAIR'S POGO (So named by the men who worked on it; officially the XFY-1 Navy fighter), is without question one of the most significant aircraft in modern aviation history. It takes off straight up and flies horizontally at more than 500 mph, and we have expert testimony that it does these things with the greatest of ease. We have seen it fly, but as we check back the sentences above, we hesitate. George A. Carroll, veteran aviation editor of the New York Journal-American, summed up the press showing of Pogo in the lead of his dispatch. "I have just seen something that is unbelievable and I don't expect you to believe it, either," he wrote. Pogo is an incredible airplane any way you look at it.

• • •

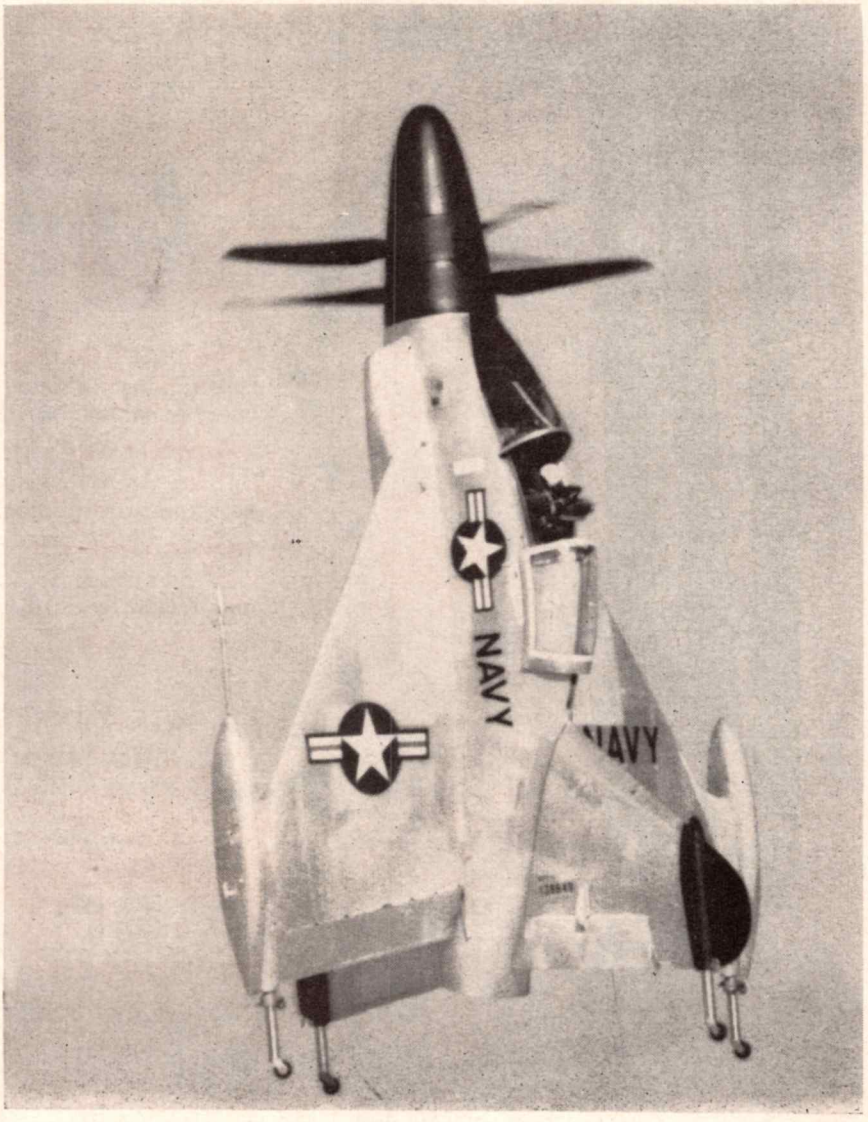
J. F. (Skeets) Coleman, Convair Engineering Test Pilot who made the press flights, agrees with these statements with enthusiasm. He points out that Pogo has an instrument board comparable to a conventional lightplane; that landing it on its tail (he has no rear-view mirror and peers over his shoulder on the descent like an auto driver in a tight parking space) is a cinch; that aerodynamically it is nothing as special as it is in the prop and engine department; and that so far as he's concerned it will turn up one of these days, possibly, as a lightplane or even a transport. Admittedly a long way into the future, these applications are not considered too seriously at the moment, of course; but the plane is so revolutionary that in terms of decades it can admittedly be developed in any one of a dozen directions.

• • •

Heading the Pogo project was Convair's veteran C. B. Carroll. The plane won a Navy design competition in March, 1951, and fabrication began 11 months later under a $9-million contract. The plane bootstraps straight up on the pull of a 5850 hp twin-turbine jet engine geared to a six-bladed, 16 ft. propeller. The engine is an Allison YT40-14. It is an adaption of the T-40, with oil pumps, lines and breathers rearranged to accommodate VTO as well as level flight without power loss. Control system was redesigned and reduction gear was modified to give a higher propeller rpm and increase the engine's thrust. Convair engineers are as high in praise of the Allison work for Pogo as they are for the specially-designed Curtiss-Wright Turboelectric propeller. An electrically-actuated control mechanism varies the pitch of the hollow steel propeller blades to keep the speed and temperature of the jet turbines within the narrow limits allowable for that type engine.

• • •

TRAGEDY ended the press showing of Convair's newest designs when the world's fastest sea-



Convair's XFY-1 VTO fighter on first untethered flight

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Choice of Controls... New Pendant, push-button, instant stop or start, up or down . . . also, double cable control.

Variable Speed... 1000 lbs., 0 to 38′ per minute . . . quieter . . . no spark hazard . . . explosion-proof motor.

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Lightweight... only 28½ lbs.—overall length, 10½″.

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plane, the YF2Y-1 Sea-Dart, fell apart and burst into flames before the eyes of the newsmen. Such events are not unique in this, the jet era: but the accident put a difficult handicap on those who made the Sea-Dart the remarkable plane that it is. They won page-one pictures and stories from coast to coast, although such tragedies usually get only routine coverage. And it cost the life of one of Convair's most gallant test pilots, Charles E. Richbourg. We can add only one optimistic footnote to this disaster: as we go to press, we learn that work on the Sea-Dart will continue. Such an unusual plane—rivalling even Pogo in its performance—deserves to be developed to the full in recognition of the work and sacrifices that have already gone into it, if not for its obvious possibilities in strengthening the nation's defenses.

• • •

POGO POSTSCRIPTS: An accident almost prevented Skeets Coleman from demonstrating Pogo to the press. A truck ran his car off the road on the way to the airport. He says that the plane flies so easily that helicopter chase pilots are trying to put him out of his job.

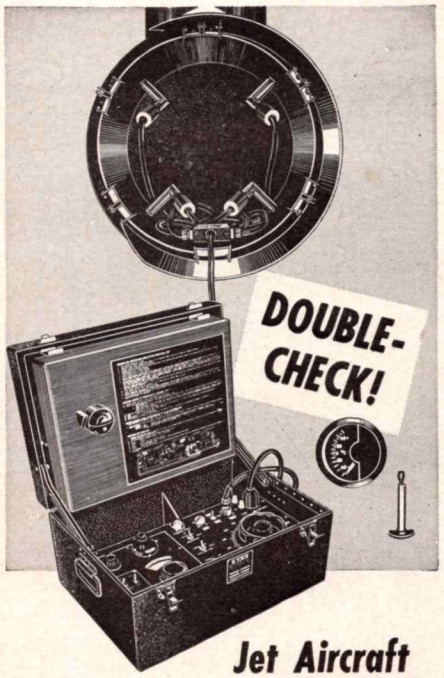
• • •

MORE POWER AND MORE PLANES on an unlimited scale are in U. S. aviation's future—and this on a peace-time basis. That is among the best aircraft news stories of recent weeks and it comes from no less an authoritative observer than Roy T. Hurley, President of the Curtiss-Wright Corp. Mr. Hurley sees turboprop power in general use on U. S. airlines within five years. Turbojet transports will take longer, but should reach large-scale operations within the next decade. Wisely, although it may come as a surprise to some railroad observers, he sees the airplane heading surface vehicles in the future—for purely economic reasons. "Many areas in the world," he points out, "are determined to grow but cannot afford the vast cost of rail and highway systems." The answer is the airplane, supplemented by the helicopter, whose future role he sees as most important for shorthaul work. Will power be a problem? No, says the Curtiss-Wright executive, adding: "I think we will see power increases four or five times that of today within the next 10 to 15 years."

• • •

LIGHTPLANES also figured in the recent news, notably the 1955 Piper Tri-Pacer, unveiled early in November, and the announcement from Taylorcraft that they expect to have two Fiberglas business planes on the market before the end of the year. Piper is already delivering Tri-Pacers. The plane features the new 150-hp Lycoming 0-320 engine, giving a 15-hp increase over previous years. Gross weight has been increased to 2000 lbs. Useful load is 900 lbs. The plane cruises at 123 mph and 132 mph at an optimum altitude, in both instances on 75 percent power. An extra eight gallon gas tank is optional. Baggage space totals 16 cu. ft., with an additional 42 cu. ft. if the rear seat is removed. One of the Fiberglas Taylorcraft will be named the Ranch Wagon. Power is a 225 hp Continental, price in the $10,000 class. The second, The Skyliner, with a 145 hp Continental, will sell for about $6,000. Among the many advantages cited for Fiberglas, a product of the Owens-Corning Fiberglas Corporation, is that it is less subject to

Latest Navy *Fury*, the North American FJ-4 pictured during recent successful first flight (See Planes at Work, p. 65)



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JETCAL Tester is guaranteed accurate to ±4°C. at engine test temperature.

Now used by U. S. Navy and Air Force as well as by major aircraft and engine manufacturers.

• The production or maintenance engineer, pilot and *cost accountant* will readily assay the safety and savings factors resulting from Jetcal use. *We invite inquiries concerning the Jetcal Tester... and will be glad to have our engineering department help solve your heat problems.*

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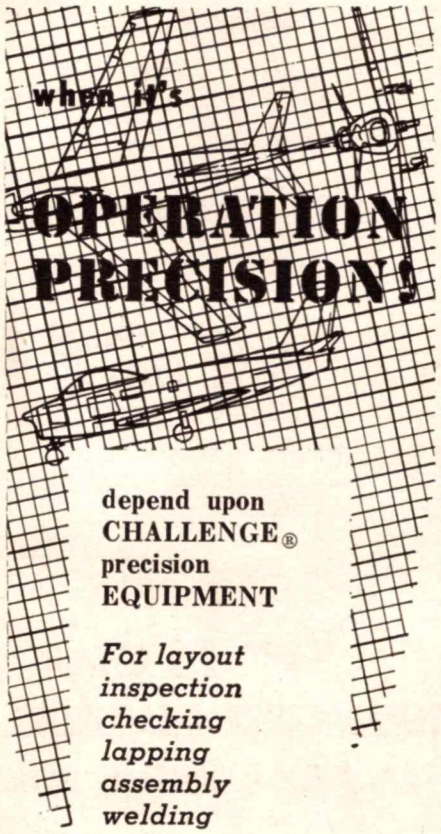

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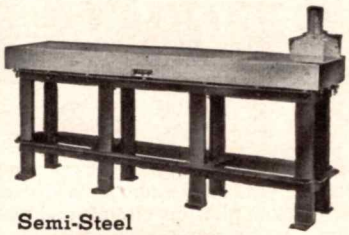
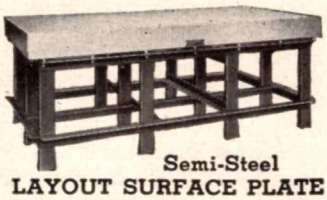


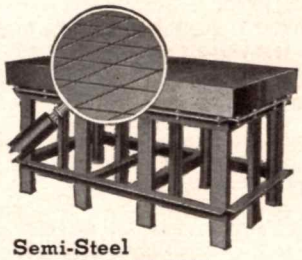
Semi-Steel
READING TABLE

for checking propeller blades. Can be scribed or graduated to your specifications. 2 sizes. Stand is equipped with lock-leveling screws.



Semi-Steel
LAYOUT SURFACE PLATE

for layout, inspection or assembly lines. Available either precision ground or planer finished. Special leveling screws. Sizes from 12"x18" to 54"x144".



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Assures perfect fit when lapping metal-to-metal joints on which no sealer is used. Plates have 1/16" grooves 1/2" apart. Write for bulletin F1759.

770

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damage than doped fabric or stressed skin construction. If damage does occur, it can be repaired with a can of resin, Fiberglas cloth and a putty knife. Production costs are also reduced, since Fiberglas fuselages may be molded in two sections only. Wings require only eight molded units.

• • •

NOTES AND SIDELIGHTS • About the world's worst handwritings belong to aviation executives, according to a survey by Norma Pencil Corporation. Some 75 percent are in the illegible category. (Engineers, however, got a high rating.) "My boss," said one secretary interviewed, "writes like an Egyptian."

A new record for high altitude parachute jumps has been set by two U. S. Air Force officers—45,200 ft., from a B-47. Captain Edward G. Sperry and First Lieutenant Henry P. Nielsen made the jumps over the Gulf of Mexico. They used new type downward ejection seats being tested at the Wright Air Development Center.

Push-button airport lighting controlled by pilots by radio has been recommended by the Radio Technical Commission for Aeronautics. A system has passed tests made last year by Bonanza Airlines and is so accurate that a pilot may light a specific field in a crowded airport area without lighting others.

How to make fire liberate the most energy in the smallest space —a vital question in jet engine development — may be answered by a saucer flame developed by Dr. Raymond Friedman and fellow scientists at Westinghouse Research Laboratories, Pittsburgh. The saucer flame enables the investigators to measure with pinpoint accuracy the temperatures at all points of the flame. The development is expected to have civilian as well as jet engine applications.

An airplane ejection seat with dual controls has been devloped by Convair-Ft. Worth, a Division of General Dynamics Corporation, Controls enable pilots to cut loose with either hand, or both. Called SACseat, the Convair device is also considered much more comfortable and injury-proof.

A compass that varies less than one degree per hour on flights over the magnetic North Pole went into operation in mid-November on the Scandinavian Airline System. It is an improved and lighter weight version of the "Polar Path," developed by Eclipse-Pioneer Division of Bendix Aviation Corporation.

Minneapolis-Honeywell's supersonic E-10 autopilot has been ordered by the Air Force in large (classified) numbers. The E-10 weighs only a third as much as the original Minneapolis - Honeywell autopilot in the supersonic series. The company also announces a $5-million order for proximity fuses.

It's taken a long time, but the first of the gigantic forging presses being built under the U. S. Air Force Heavy Press Program is

Rotor-Craft designed *Pinwheel* is world's only strap-on-the-back helicopter. Craft is rocket powered (See Planes at Work, p. 65)

Freedom's Team

At outposts of freedom near the Arctic Circle—made possible by our agreements with other governments which stand with us against aggression – U.S. Air Force men are now standing around-the-clock, around-the-calendar guard. Backing them up are the resources of American science and industry which have produced the Northrop Scorpion F-89 all-weather interceptor. The F-89 is America's heaviest-armed fighter. Wing-tip "hornet's nests" which carry 104 rocket projectiles are coupled with the latest electronics to make the F-89 a deadly aerial destroyer, capable of striking a bomber 45,000 feet and more above the earth. These jet home defenders are one of many modern weapons created by the engineering and production complex of Northrop Aircraft, Inc., since 1939 America's first company in the vital design, development and production of all-weather and pilotless aircraft.

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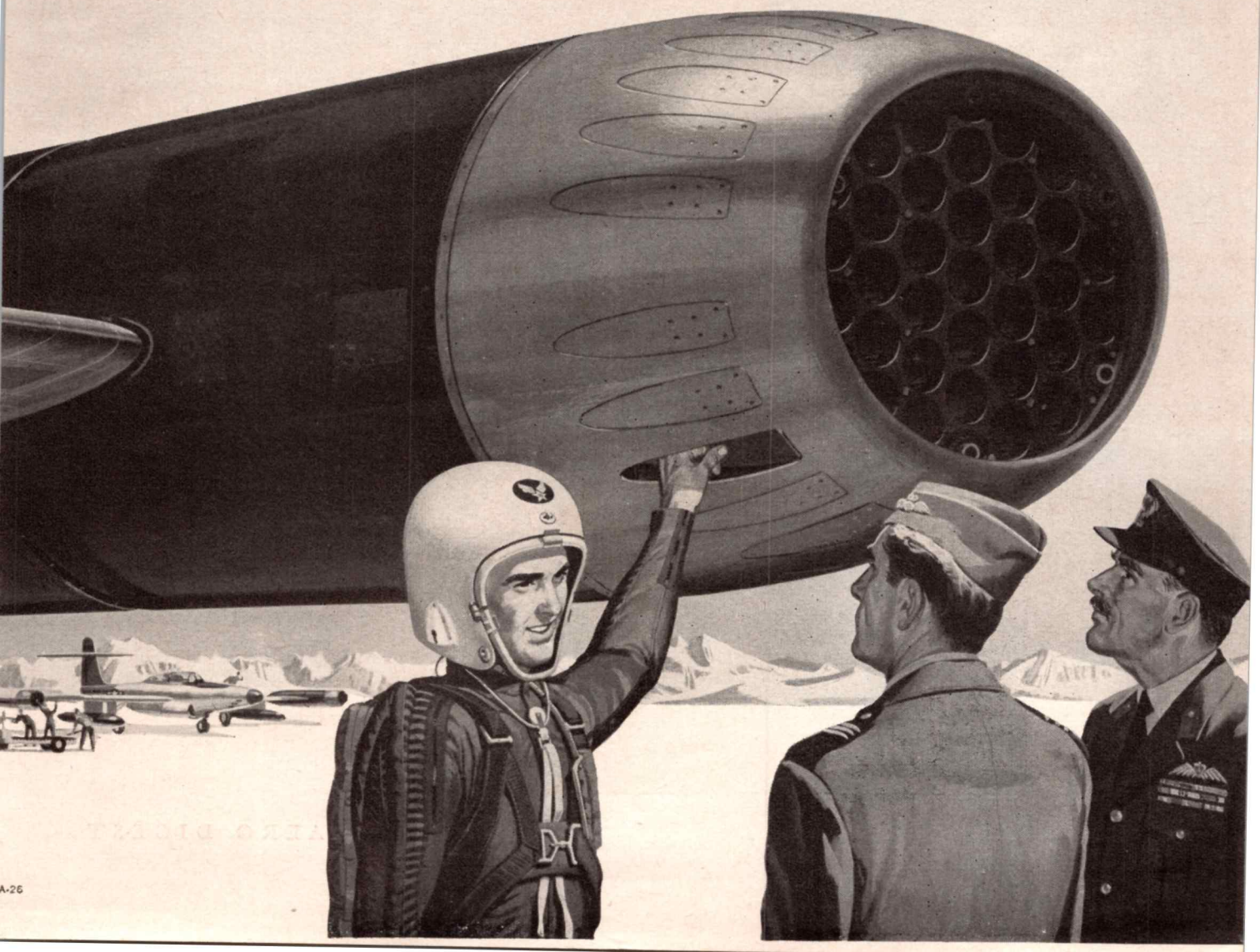


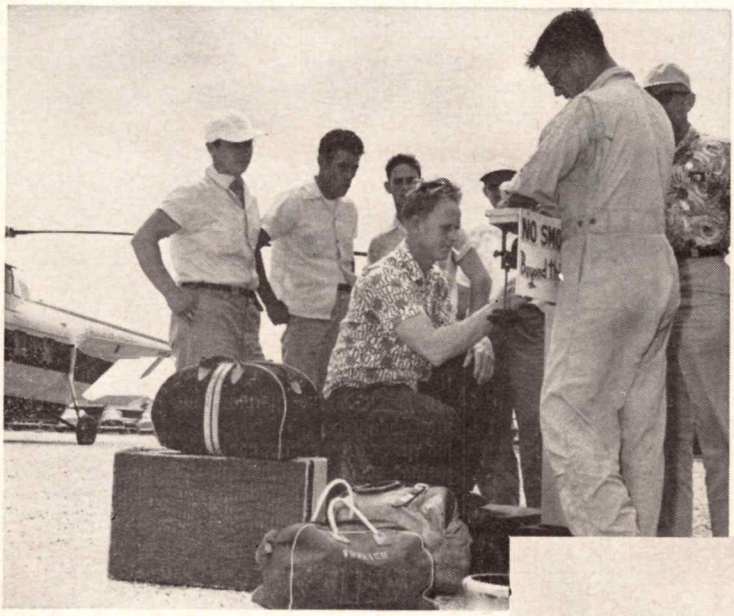
A-26

Smooth "High Road" to

SMOOTHEST and most efficient offshore crew transportation today is the modern helicopter, an aircraft proved in this tough assignment and backed by many millions of hours of operation throughout the world.

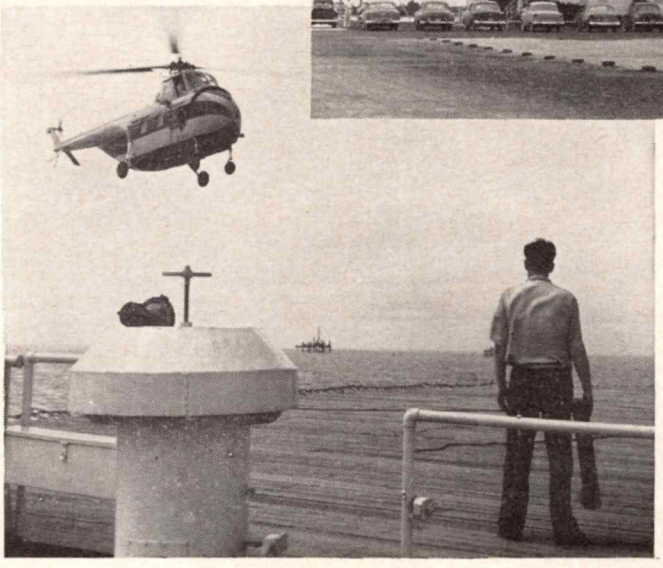
Around the clock, dependable Sikorsky helicopters now provide new speed, safety, seasick-free comfort and high availability in the transportation of operating personnel between the mainland and offshore stations.

The pictures on these pages tell the story. They illustrate the smooth "high road" to offshore drilling barges in the Gulf off Texas and Louisiana.



1. **OIL CREWMEN** and their baggage are weighed in before boarding an S-55 for a 30-minute flight from the mainland to a barge 45 miles out in the Gulf.

2. **S-55 HELICOPTER,** loaded with offshore crewmen, takes off from the heliport on a Grand Isle office parking lot.



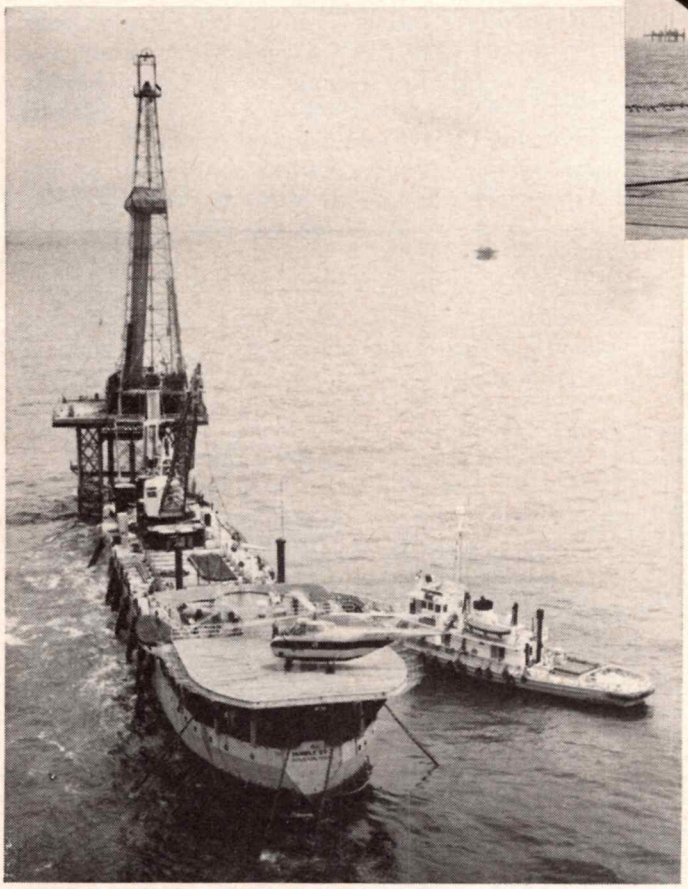
3. **THIRTY MINUTES** later the Sikorsky comes in for a gentle landing on the flight deck 45 miles from Grand Isle, Louisiana. By boat, the trip takes tiresome hours.

Offshore Drilling Barges

Petroleum Helicopters, Inc. of New Orleans, demonstrates how offshore transportation can be speeded . . . how problems can be eliminated or greatly simplified . . . how costs can be reduced. Already as many as 110 men per day fly to work offshore for a major oil company. Intangible values include higher morale, greater safety and availability of an emergency vehicle without peer.

For information on how your company can increase the efficiency of its operations offshore, or anywhere, with transport helicopters, write on your company letterhead or call today to General Manager, Sikorsky Aircraft, Bridgeport, Connecticut.

5. PASSENGERS alight after safe, easy flight. The helicopter makes any number of required trips each day, handling a steady flow of passengers in each direction between several rigs and the mainland.



4. CONVERTED LST with flight deck aft easily accommodates the big Sikorsky helicopter. More and more ships and rigs are being equipped with such heliports. The helicopters eliminate the need—and cost—of standby safety boats at drilling rigs.

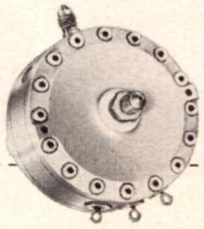
Sikorsky Aircraft

BRIDGEPORT, CONNECTICUT

One of the Divisions of United Aircraft Corporation

Giannini
HIGH PRESSURE
TRANSMITTERS

Giannini high pressure transmitters accurately translate pressure into proportional electrical signals of relatively high power, and require little or no amplification.

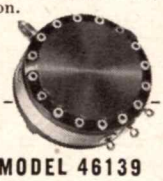


MODEL 46129

These high pressure transmitters incorporate a unique direct coupling arrangement between bourdon tube and potentiometer element which obtains movement amplification without the use of gearing or linkage, thus giving high sensitivity, repeatability, and low hysteresis.

Ranges from 0-100 psi. to 0-6500 psi., (abs., diff., gage). Instruments are available for operation under either normal or extreme conditions of vibration and acceleration or for corrosive media.

Other models also available for low pressure and high altitude applications. Write for complete engineering information.



MODEL 46139

G. M. GIANNINI & CO., INC.
AIRBORNE INSTRUMENT DIVISION
PASADENA 1, CALIFORNIA

Giannini

nearing completion at Aluminum Company of America's Cleveland works. The press is capable of squeezing aluminum aircraft sections into shape with pressures up to 50,000 tons. It will go into full production early next year.

Pilots are learning how to shoot by television according to word from Air Force Air Research and Development Command, Baltimore, ARDC has a new fixed gunnery trainer in the works that can be operated in a conventional classroom. It uses a television pick-up and projection system to portray a realistic air-to-air or air-to-ground combat problem. The device was developed and manufactured by Rheem Manufacturing Company, Philadelphia.

Hamilton Standard Division of United Aircraft Corporation has doubled its space for pneumatics laboratory work at its Windsor Locks, Conn., plant. Operations in the new space will begin the first of the year. New equipment in the quarters will include a sand and dust test chamber, a shock test rig, a centrifuge, a spin pit for whirling turbine rotors to destruction, and a simulated jet plane cockpit.

Los Angeles Airways, Inc., who are going into the helicopter passenger field, have awarded the Garrett Corporation's AiResearch Aviation Service Company Division a contract for conversion of four Sikorsky S-55's to passenger-carriers. AiResearch Manufacturing Co., incidentally, celebrated its fifteenth birthday anniversary the other day. Staffed with three persons in 1939, it is now Los Angeles County's seventh largest manufacturer.

The bronze "Oscar of Industry" for the best annual report on its industrial classification went this year to Menasco Manufacturing Company, Burbank. Menasco is the nation's largest manufacturer exclusively of aircraft landing gear components.

A $1-million building will be added to the plant facilities of Westinghouse Electric Corporation's Air Arm Division. Ground was broken for the new structure early in November in Baltimore about a mile from Friendship International Airport.

Convair-Ft. Worth announces installation of a 65-ton milling machine to speed work on B-58 supersonic bomber construction.

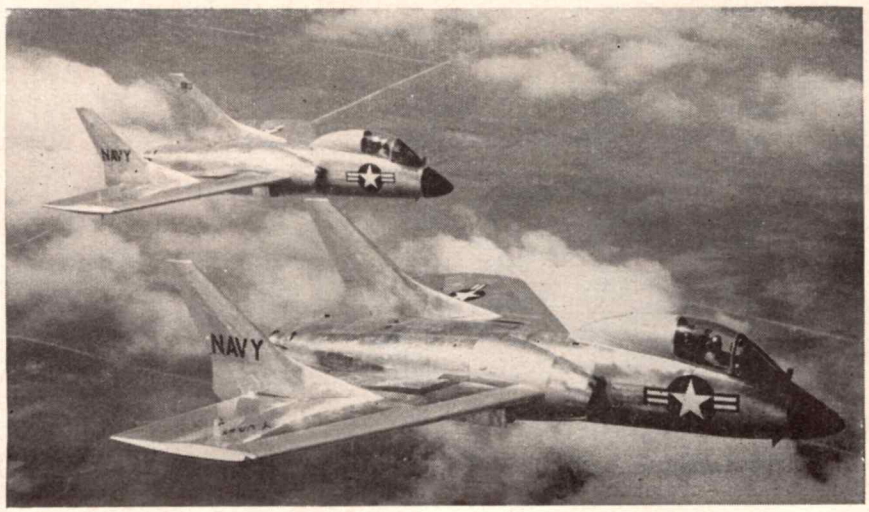
After more than a decade of active duty, the Boeing B-29 Superfortress is retiring. Final units flew home early this winter. Crews are turning to another Boeing for flight duty—the B-47 Stratojet.

Fred H. Rohr, President of Rohr Aircraft Corporation, announces the opening of a new assembly plant at Winder, Ga. The unit will assemble power packages for the C-130, now in production at the Lockheed Marietta, Ga., plant.

Lockheed has also signed Beech Aircraft Corporation to manufacture T-33 jet wings. Production will now extend to next fall on a $1.8-million contract.

FRED HAMLIN

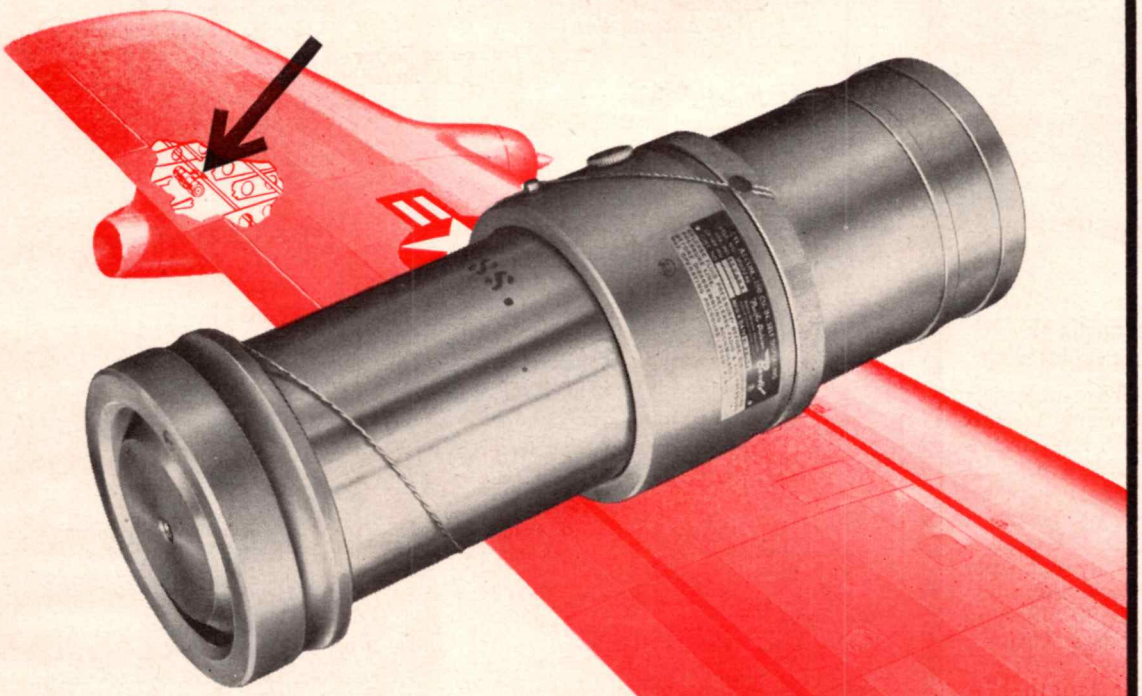
Chance Vought *Cutlass* F7U-3 continues as production model after contract cancellation of the A2U-1 attack version



BENDIX-PACIFIC

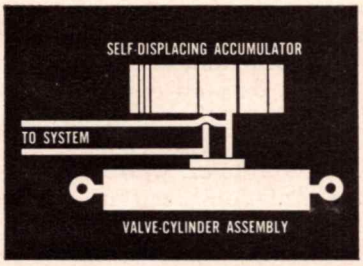
SELF-DISPLACING HYDRAULIC ACCUMULATOR

assures instant response in remote systems

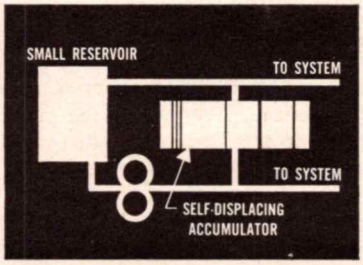


Bendix-Pacific Self-Displacing Accumulators can eliminate serious operational handicaps in remote installations and in closed surface control systems.

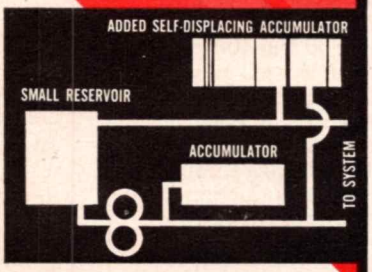
The Accumulators incorporate double chambers and double pistons joined by a piston rod. Half the unit operates as a conventional accumulator while the second half acts as a displacement sump.



For remotely located hydraulic valves which require sudden changes in rates of flow, the problems of large lines, weight, hydraulic hammer and pressure drop are virtually eliminated with the new Accumulator. It is located close to the control valve, resulting in much **faster action** and less pressure surges because the return oil travels a minimum distance.



Use of the Bendix-Pacific Self-Displacing Accumulator in an independent, completely closed hydraulic system simplifies the reservoir problem. Instead of designing a pressurized reservoir capable of accommodating the full displacement of the accumulator, it is merely necessary to provide a reservoir capable of handling expansion of the fluid, plus piston rod displacement, if any.



In systems already designed which require the addition of an accumulator, use of the Bendix-Pacific Self-Displacing Accumulator may eliminate reservoir redesign as the total system volumetric change remains the same.

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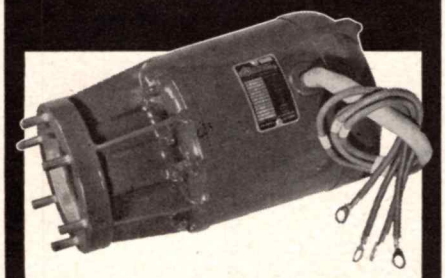
BENDIX ★ ★ PACIFIC

THE NAME Bendix AVIATION CORPORATION MILLIONS TRUST

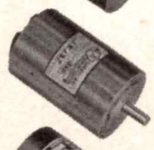
15 Horse Power in a 7"x 11" case!



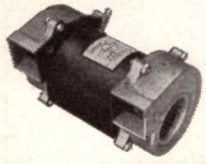
A typical example of American Electric engineering

This 400 cycle 3 phase motor is a special custom-developed aircraft design. Rated at 15 h.p. continuous duty at 11,500 r.p.m., it actually produces 19 h.p. on intermittent duty, yet occupies less than ¼ cubic foot. Weight is 32 lbs.—approximately ½ h.p. per lb. Fungus-proof, corrosion resistant, meets AND 20002 type XIIB mounting specifications. Temperature range: −67° to +131° F. Motor length: 7", Coupling extension 4".

MINIATURE MOTORS for all PURPOSES!



American Electric Motors are also built in an almost unlimited range of miniatures for 60 and 400 cycle operation as well as variable frequencies. All feature low weight, compact size and meet high temperature requirements. Supplied in induction or synchronous types for motor drives, propeller fans and centrifugal blowers. Wire, write or phone for data and quotations.



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We take pleasure in announcing two important AERO DIGEST events during the last month. Arrangements were completed to move national headquarters of the magazine to the National Press Building, 14th and F Streets, N.W., Washington, D. C. The move will be made December 1, after which date all editorial and circulation correspondence should be sent to that address. In addition to the four new editors announced last month, a fifth was added during November. He is Henry P. Steier, who will devote his time to concentrated coverage of Aviation Electronics. Mr. Steier comes to his Washington post from International Business Machines Corporation, Endicott, N. Y., where he was Managing Editor of the Laboratory Publications Department. An electrical engineering graduate of Columbia University he was a Senior Design Engineer with the Radio Corporation of America where for ten years he specialized in cathode ray tube development and circuit design. He has written extensively for the trade press, is a member of the Institute of Radio Engineers, and the American Association of Industrial Editors.

THE EDITORS

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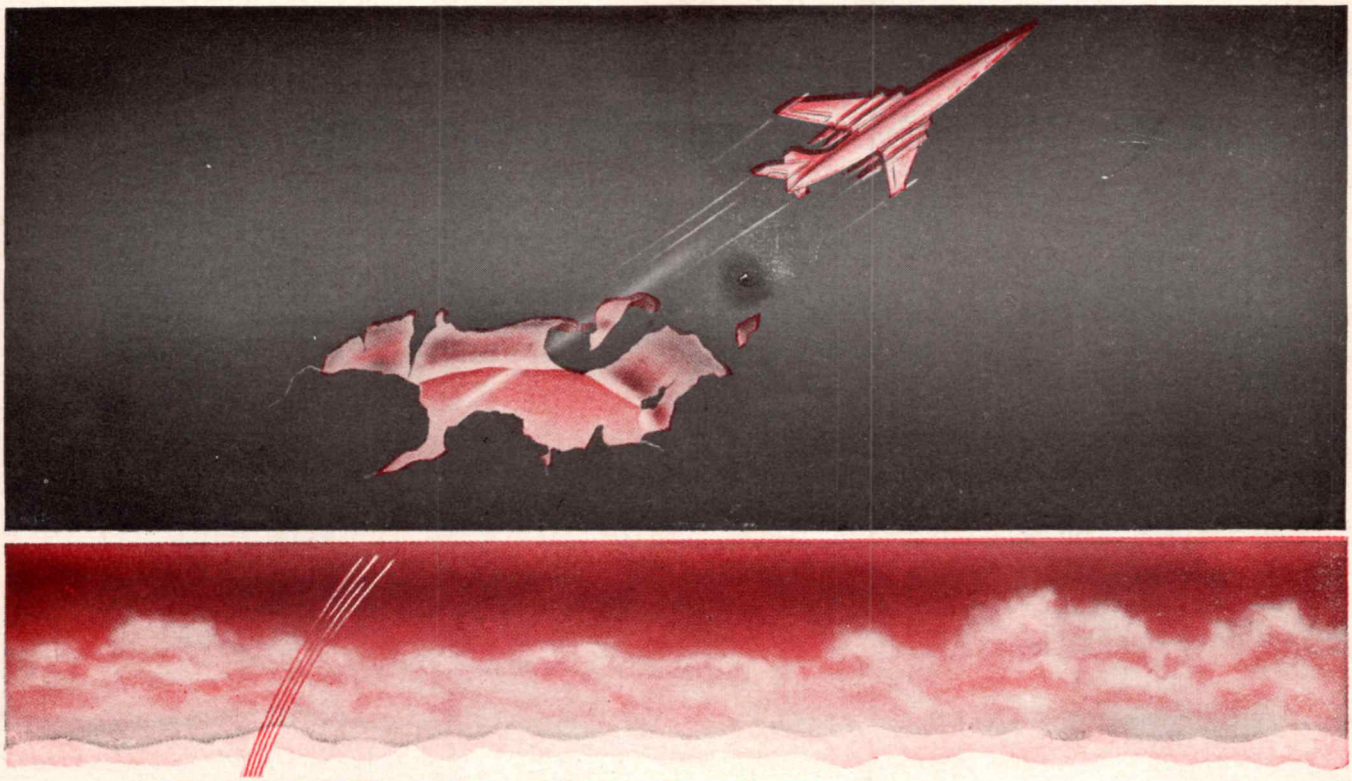
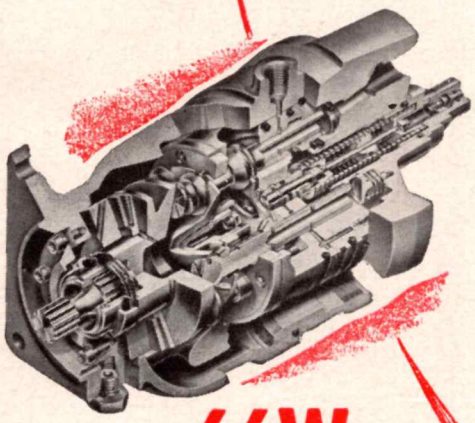


STRATOPOWER Is Ready for the Planes Which Will Break Through Today's Ceilings

The modern STRATOPOWER Hydraulic Pumps are ready and able to perform efficiently well beyond heights penetrated by piloted aircraft. They've proved it! In Rockets, Guided Missiles and under the simulated conditions of the ionosphere STRATOPOWER Pumps *pump!* They are built to perform at full efficiency and with complete dependability under the extreme conditions and variables imposed by projected speeds and service ceilings.

STRATOPOWER Pumps draw fluid from unpressurized reservoirs to sustain system pressure at altitudes where other pumps, dependent upon pressurized reservoirs, would be unable to supply system demands. Thus, they afford that vital added safety factor for high altitude operation . . . system actuation is assured, even though reservoir pressure may be lost.



SERIES 66W

PRESSURE COMPENSATED HYDRAULIC PUMPS

Designed to simplify hydraulic systems and to render the exacting control of such circuits more dependable. The range of models in these variable delivery pumps includes sizes delivering from 2 to 10 gpm at 1500 rpm with operating pressures to 3000 psi and speeds to 4500 rpm.

There is a STRATOPOWER Hydraulic Pump to provide the efficient source of fluid power for your requirement. Write for full information today.

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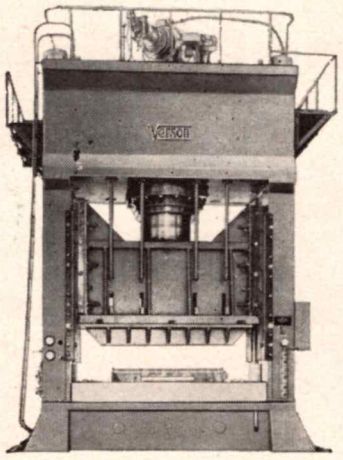
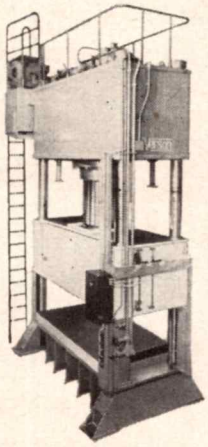
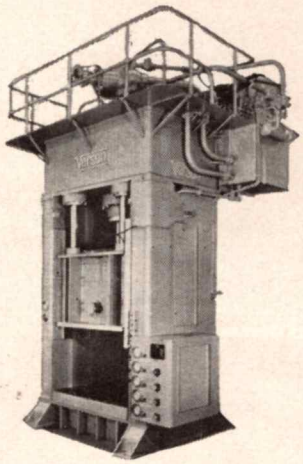
A COMPLETE RANGE OF HYDRAULIC PRESSES



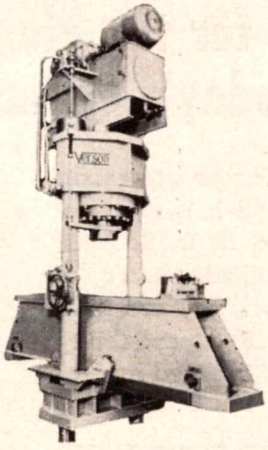
1200 ton straight side



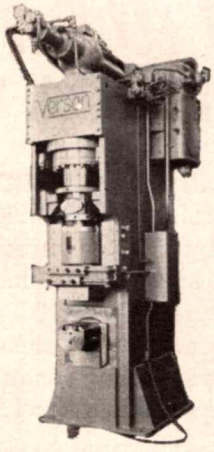
750 ton post type



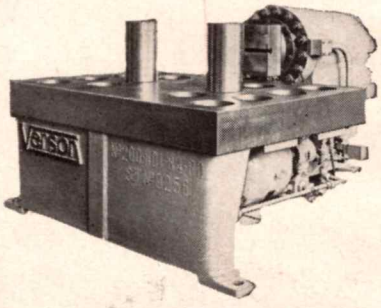
400 ton double action



400 ton straightening press



300 ton horn press



200 ton bending press

Write for your copy of the new Verson Hydraulic Press Catalog which contains detailed data on the entire Verson hydraulic line.

In the Verson line of hydraulic presses, there is a size and type to meet virtually every need from 75 tons up. In addition to the more common types illustrated above, Verson also manufactures such special models as gap type presses, bulldozers, hobbing presses, rubber pad cutting presses and pipe forming presses. If there is a question as to whether a mechanical type or a hydraulic type is best for your job, Verson, as a leading manufacturer of both types, is able to make unbiased recommendations.

Whatever your press problem, bring it to Verson and take advantage of our extensive know-how and experience.

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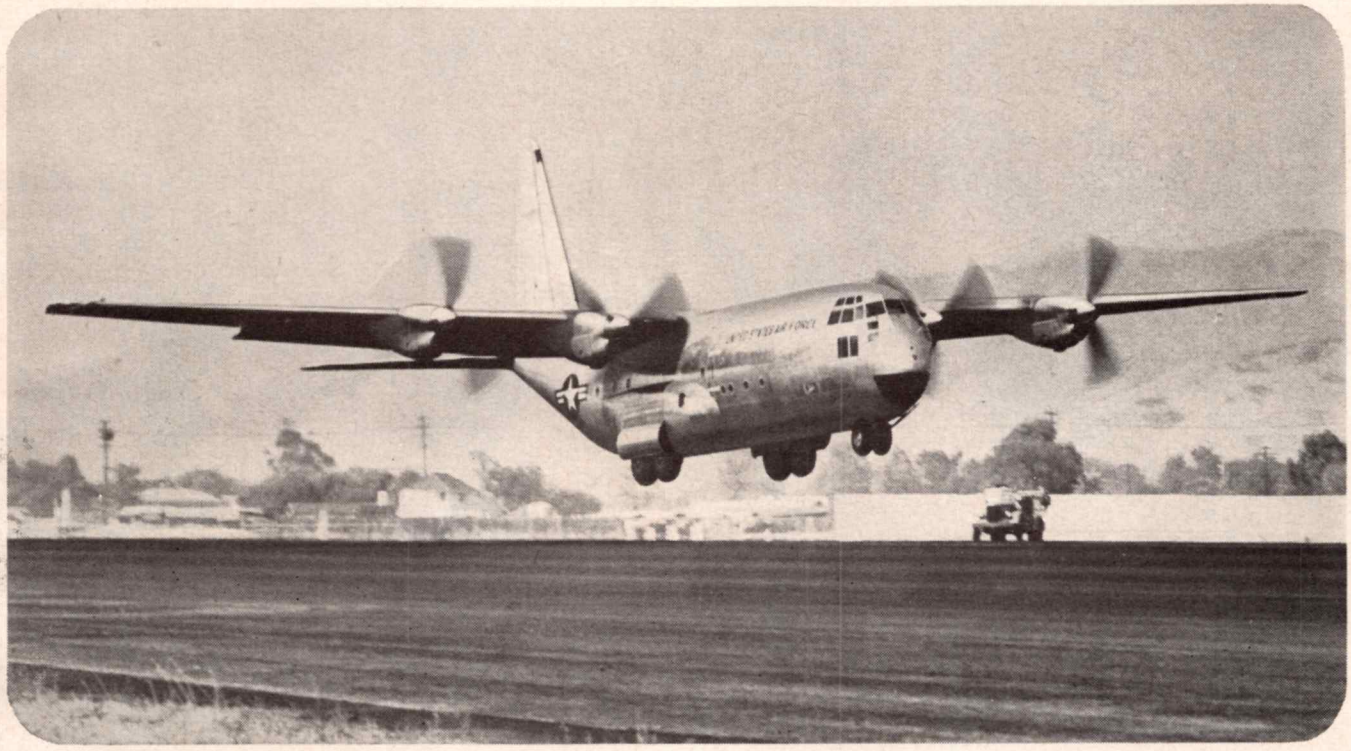
New Turbine-Powered Cargo Carrier

hauls big pay loads faster



Allison T56 Turbo-Prop Engines Power New Lockheed YC-130 Transport

The initial flight of the YC-130 Medium Cargo Transport marks another great forward stride in transport aviation.

This giant carrier, built by Lockheed for the U. S. Air Force, is the first U.S.A.F. cargo plane designed from the very beginning for Turbo-Prop engines.

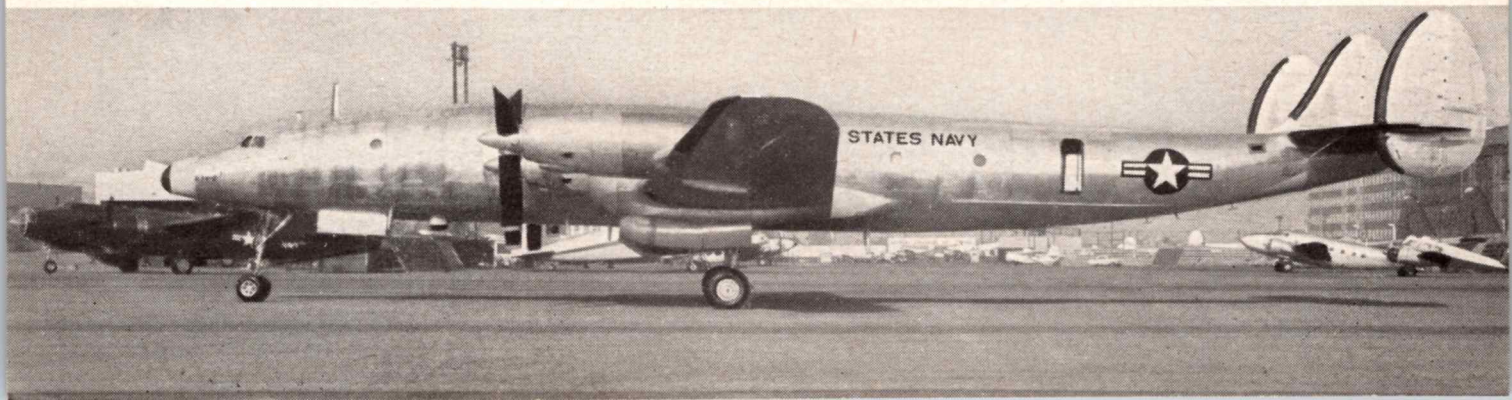
Powered by four of the new Allison T56 Turbo-Prop engines, this great new cargo airplane can haul heavy pay loads long distances at speeds required by our new modern combat jet Air Force. It is ideally suited to carry many types of heavy military equipment, on either long-range operations or in close support of troops. It also can be fitted as a combat troop carrier or an ambulance plane. The YC-130 can operate from shorter runways with greater rate of climb than either reciprocating or Turbo-Jet engine aircraft.

All this, plus its economical use of lower cost fuel, label the Turbo-Prop engine as the "work horse" power for future transports. And Allison, with its unmatched experience in high-powered Turbo-Prop design and manufacture, today offers both T56 and T40 engines to serve a broad range of modern flight requirements.

GM GENERAL MOTORS Allison Division of General Motors, Indianapolis, Indiana

BIGGER RADOMES FOR MORE PROTECTION. The radar Super Constellation picket plane is an extremely vital unit for U. S. protection. It can warn the nation hours earlier of enemy attack, because it has long range, high speed, plus six tons of electronic intelligence packed in radomes as big as swimming pools (like the bottom one pictured above).

WORLD'S FASTEST PROPELLER-DRIVEN AIRPLANE is turbo-propeller Super Constellation for the U.S. Navy (shown below). Now flying, it will be capable of speeds 100 mph faster than any propeller airplane now in service. Powered by Pratt & Whitney T-34 turbo-propeller engines, this plane promises new speed, new performance and greater economy potentials.



WEST TRANSPORT CONCEPT is Lockheed's C-130A turbo-prop ult transport, shown here in its dramatic first flight. Now in production at vernment Aircraft Plant No. 6, operated by Lockheed's Georgia Division in Marietta, this giant plane literally jumped off the runway in one-third the distance required for today's commercial transports. This new cargo plane incorporates scores of new features for better handling of troops, materiel and equipment.

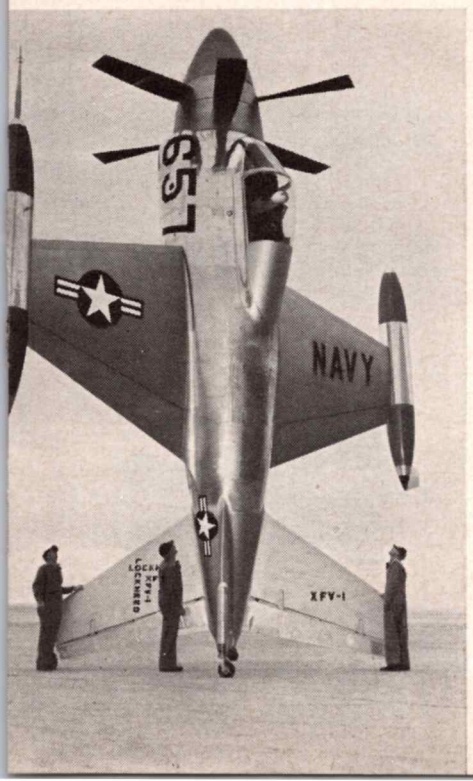
6 New Lockheeds for U.S. Protection

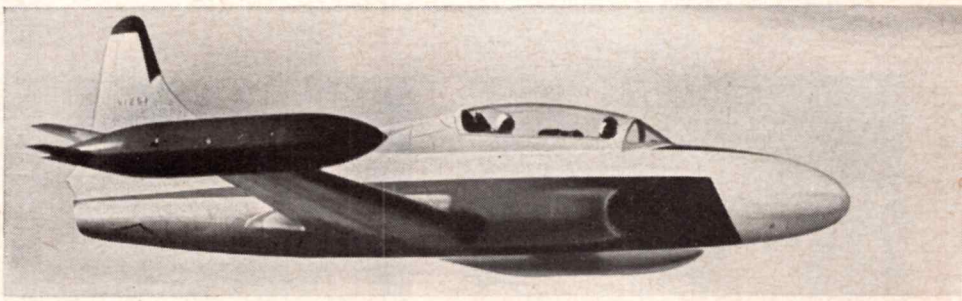
werful Team Includes Truly Amazing Jet Fighter, High-Speed Assault Transport and Vital Picket Plane

54 has been a notable year for Lockheed, in research, velopment and production. Six new models in one ar include: world's fastest propeller-driven transport; rld's first turbo-prop assault transport; latest ver- n of the Navy's Neptune anti-submarine patrol mber; a new advanced jet trainer for the Navy, and uly amazing jet fighter, the F-104 now in production, ich is too secret to photograph or describe.

On these pages are shown all new models except the tricted F-104. Also photographed is the vital Super nstellation picket plane, with fantastic top and bottom lomes. The bottom radome, for example, creates be- een 30,000 and 60,000 pounds of drag pressure, yet hold it securely in place only 10 bolts are needed, due ingenious Lockheed design.

LIES STRAIGHT UP, LANDS STRAIGHT OWN. This is the Lockheed XFV-1 Vertical Ascender, revolutionary new concept of aircraft developed in operation with the U.S. Navy. Now, every ship n have its own protective fighter umbrella, every back rd could become a landing field if needed.





NEW NAVY ADVANCED JET TRAINER. Often called the world's safest jet airplane, Lockheed's new T2V-1 advanced trainer for the U.S. Navy has so many new safety and performance features it can be used for carrier landing and takeoff and can utilize existing short fields for propeller aircraft. By training better jet pilots quicker, this trainer boosts Navy's ability to protect America. Another product of close Navy-Lockheed design teamwork.

ADVANCED GUIDED MISSILE SYSTEMS DEVELOPMENT

Eminent scientists, nuclear physicists, and engineers have joined forces at Lockheed's new Missile Systems Division in Van Nuys, California. Their mission is to solve the nation's prime defense problem, to give our armed forces *totally* reliable means of delivering our defensive and retaliatory weapons to their targets. To accomplish this vital task, Lockheed has appropriated $10,000,000 for a program of laboratory research and development.

Lockheed

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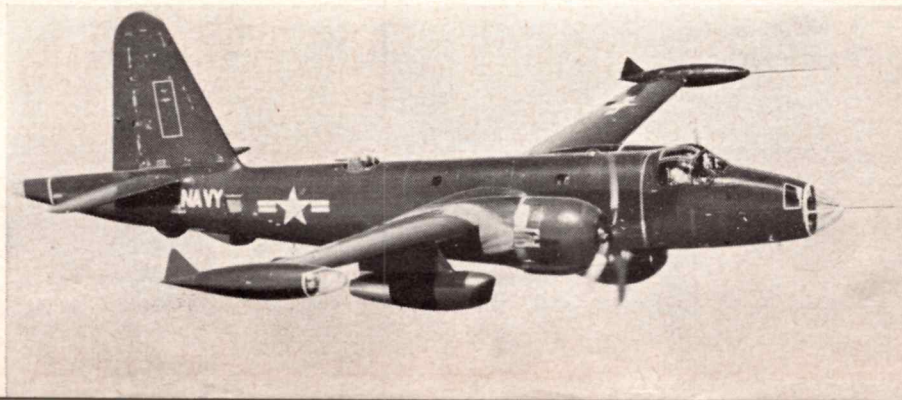
Georgia Division—Marietta, Georgia
Missile Systems Division—Van Nuys, California
Lockheed Aircraft Service—Burbank, California
Lockheed Air Terminal—Burbank, California

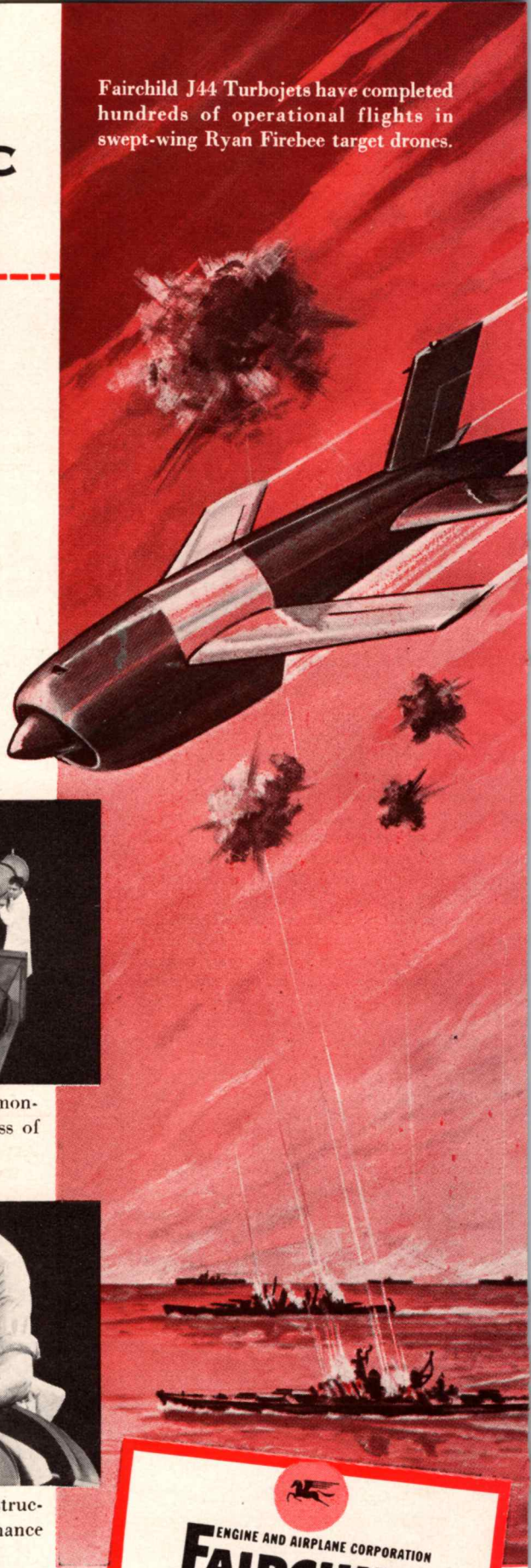
LOOK TO LOCKHEED
FOR LEADERSHIP

NEWEST SUB HUNTER is the Navy's latest version of the Lockheed P2V Neptune Patrol Bomber, a rugged, radar-laden flying sentinel with many secret missions. Its primary job: patrolling coastal waters against possible enemy submarines. Note new jet engines for added speed, power.



POWER...FOR TRANSONIC GUNNERY TRAINING!

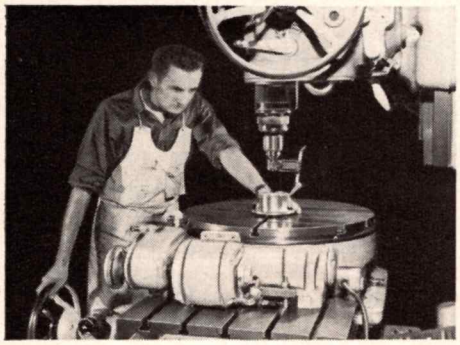
Fairchild J44 Turbojets have completed hundreds of operational flights in swept-wing Ryan Firebee target drones.



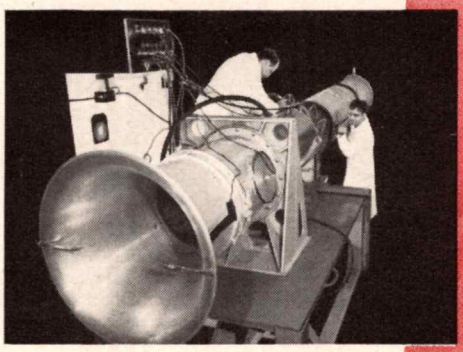
Fairchild's J44 Turbojet, designed for powering remotely controlled drones and missiles, is in production for the U. S. Navy to provide much-needed gunnery training with transonic targets for the major military services.

The J44 is a low-cost, easy to maintain engine capable of repeated flights and long-service-life. Its rugged construction withstands repeated launchings from ground cradles, shipboard catapults or from mother planes in the air.

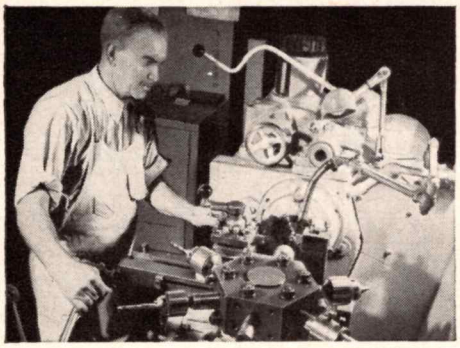
Creative thinking and advanced design techniques incorporated in the J44 and other turbojets, as well as new type propulsion systems for underwater ordnance, keep the Fairchild Engine Division in the forefront of powerplant development.



Efficient production design of the J44 Turbojet requires only standard tooling—means economical production.



In actual service the J44 has demonstrated performance far in excess of original engineered service life.



Fairchild Engine specialists have years of experience in powerplant design and manufacturing.

The simplicity of the J44 construction means easy field maintenance using only standard equipment.

ENGINE AND AIRPLANE CORPORATION

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Who Gets the Aid and Comfort?

By WILLIAM FRYE

Military Editor, **AERO DIGEST**

Security should be so balanced that the enemy gets neither aid nor comfort—but stupid restrictions must not hinder our know-how and scientific progress. An expert looks at one of the most serious problems of defense —and reports on some significant progress promised for the future.

COL. SID RUBINSTEIN, USAF, is a man with a chamber of horrors. He has assembled it with patient enthusiasm, and keeps it ready for display in the Defense Department's Office of Domestic Security where he is a division chief. It consists almost entirely of clippings from scientific, technical, and less learned publications, all of them dealing with some aspect of weapons- or equipment-development, mounted on huge sheets of cardboard in a manner best calculated to demonstrate Colonel Rubinstein's thesis that security is being played hob with.

Not to offend sensibilities by naming other publications which figure in the Rubinstein exhibits, suffice it to say that AERO DIGEST is high on his list. It might even be No. 1 on his list. Anyone seeking a really fervid outburst of moral indignation need only mention to Colonel Rubinstein the July 1954 issue of this magazine—dealing with the progress of missile science. It is Colonel Rubinstein's passionate belief that such intelligence summaries ready-made for the Russians have got to be put a stop to.

I will return later to Colonel Rubinstein, his chamber of horrors, and his problems. He has real ones, even if the chief offenders are not exactly as he has identified them. He had to be mentioned first, because he is a kind of central repository of all the military alarm which almost certainly provided the inception of a new government attempt to deal with the cumulative intelligence value of *unclassified* information which is freely published in this country.

That attempt is being started by the new Office of Strategic Information, set up in the Commerce Department on November 5 by direction of President Eisenhower, on the recommendation of the National Security Council.

To head up this new effort to enlist the voluntary efforts of the business community (editors and publishers are included here, but they're far from being the only ones), Secretary of Commerce Sinclair Weeks borrowed R. Karl Honaman from the Bell Telephone Laboratories on a part-time basis.

It is Mr. Honaman's job to get the cooperation of industrial leaders, publishers, and Federal officials "to prevent unclassified strategic data from being made available to those foreign nations which might use such data in a manner harmful to the defense interests of the United States."

"In this cooperative effort at self-protection," said Secretary Weeks, "we will undertake to revitalize the voluntary system of carefully evaluating the export of scientific, engineering and other information of a non-statistical nature which, while unclassified, might nonetheless be prejudicial to our national security if it fell into unfriendly hands.

"Such watchfulness would not take the form of censorship. . . . The key to success of this program

AERO DIGEST
America's Premier Aeronautical Magazine
Vol. 69 No. 6 December 1954

lies in the cooperation of all who develop and disseminate our national know-how."

Now, at first glance, all this looks like another try of the kind made in 1948 by the late Secretary of Defense Forrestal and Dr. Vannevar Bush, then Chairman of the since-defunct Research and Development Board. But the first glance may give the wrong impression.

The Forrestal-Bush move was aimed chiefly at classified information "leaks", and was a serious attempt to meet a serious problem by engaging editors and publishers to censor themselves, for a specific purpose, with the problem identified and the solution prepared for them by the National Military Establishment.

It got nowhere. Editors and publishers, individually and as a group, were unwilling to assume the responsibility of speaking for all editors and publishers (or to grant that authority). Even more important, the editors quite properly were unwilling to assume any part of the government's responsibility for classifying its information and controlling its own release procedures.

Mr. Honaman, a careful, cautious, portly man of about 60, with a habit of pursing his lips thoughtfully while he talks with astonishing frankness, is not only able to profit by the Forrestal-Bush example, but as Director of Publications for Bell Laboratories, he knows enough of the complexities of the problem, of the need of free exchange of scientific information, not to assume the matter can be dealt with quickly by any such direct and pat formula as might appeal to military single-mindedness.

While he recognizes that so much concern would not have become evident if no problem existed, he has given no indication yet that he believes the problem has been correctly identified. (Nor was his discovery of one of his own Bell publications, duly cleared by Security Review Branch in Defense Department, as an exhibit in Colonel Rubinstein's chamber of horrors exactly calculated to convince him that all the transgression is on the publishing side!)

Before he is through, Mr. Honaman, who is as completely aware as any scientist in whatever research laboratory that the free exchange of information is essential to scientific progress, may find the promotion of such a free exchange a very real part of his "program" (as yet, he has no "program"), along with a campaign to convince scientists that they are not the intended victims of a general anti-intellectual attack.

In point of fact, material published in truly scientific journals or in papers before learned societies probably contains less information of the type that disturbs the security-minded military than any other type of publication —although an occasional hair-raising example can be culled from them. The mass circulation magazines and the daily press, aimed at the general reader, contain little more. It is the technical publications, those concerned with the application of the research scientists' discoveries, with technological and manufacturing know-how, which worry the government on the score of intelligence data.

Which brings us back again to Colonel Rubinstein and his chamber of horrors. It is disturbing to find the onus for a grave security disservice to the nation placed entirely, at least by implication, on the manufacturers, advertising copy writers, and editors who publish information which, after all, is released to them by the military services. It is disturbing to find an apparent assumption that a compilation, or summary, of this kind of new-weapons information by a magazine of the type of AERO DIGEST is a damaging contribution to the military intelligence agents of potential enemies, as though the agents of those potential enemies had not collected, analyzed and assessed all of it long before the editor could get around to doing the job for them.

It is even more disturbing to hear officials of the Defense Department making serious noises—as they are—about classifying such information as the annual military budget, permitting only an overall total, or at most a breakdown into a few broad and thoroughly concealing categories, to be made public. But that is another problem.

While Mr. Honaman moves quietly about his initial task of assembling from all officials in all government agencies all the information they have which they think constitutes or identifies a problem, so that he can analyze all their facts and opinions and come up with his own tentative answers on problem and solution, it is disturbing to find the military waiting skeptically for him to produce results, before they set up their own organization to take direct and vigorous action.

It may be a long time before Mr. Honaman reaches the point of taking the problem or problems up with anyone outside the government. Meantime, the military departments are pressing for action.

As a matter of fact, if Colonel Rubinstein will re-examine his chamber of horrors, and if Mr. Honaman will keep his eyes and ears open as he makes haste slowly with his fact-finding, they may discover that military blabbing is their real problem. Determined to keep or gain public prestige by proving their alert modernity, the services compete constantly with each other in their public announcements of new developments.

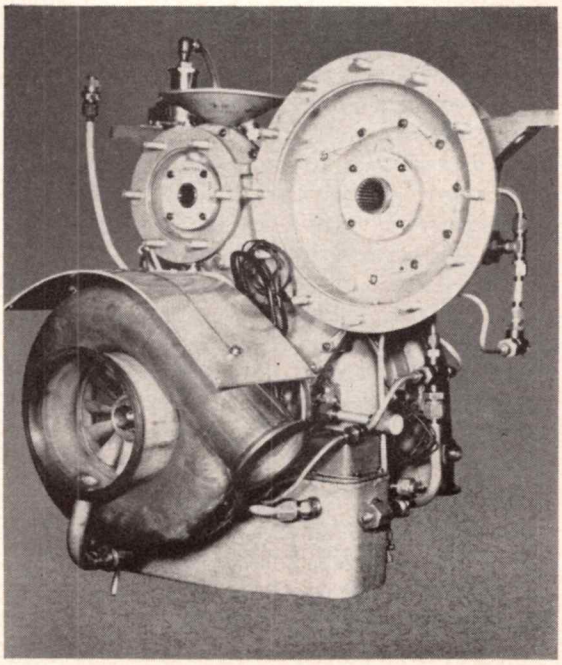
If the security problem in this area is as grave as the military say it is, then tighter classification procedures and a release policy geared to national security instead of to service vanity might be better calculated to protect the country's interest than an effort to put the finger on the users and the publishers who are interested, and who print and read the information released to them.

But if security restrictions are to be tightened on technical information, there had better be a careful search for the point at which the drying up of the information stream becomes more damaging to the long-range security of the United States than any intelligence compilation based on weapons passing from the experimental to the production stage.

For the proper formula by which to determine whether to withhold information from the public is not the stock military "information of value to the enemy," but, rather, information which, if published, aids the enemy without giving comparable or greater value to our own people. END

Savings in weight and bleed air flow requirements claimed by company's first turbo-machinery product

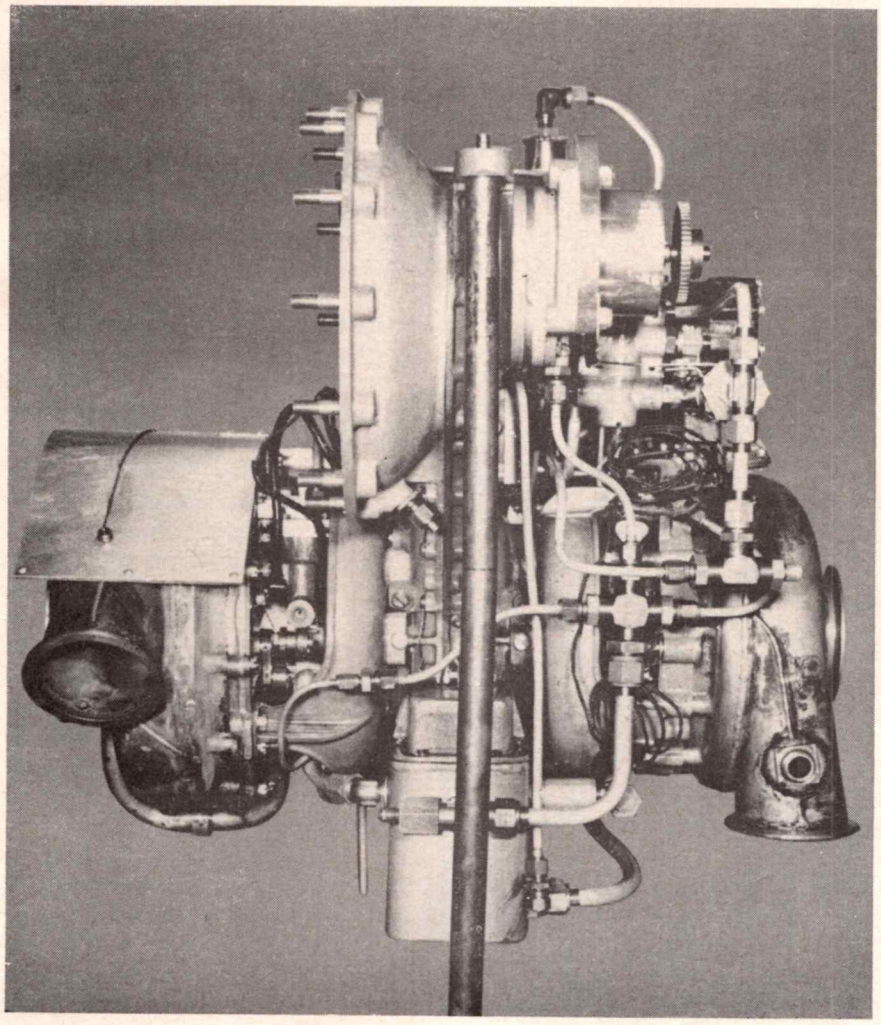
By George McLaughlin



Side view of the system showing the cold turbine

New Hydro-Aire Turbine System

Back view of "Frijadrive" showing cold turbine left and power turbine right



DEVELOPMENT of a radically new turbine system for providing air conditioning and accessory-drive power in aircraft, was announced last month by Hydro-Aire, Inc., Crane Co.'s aviation subsidiary, Burbank, Calif.

Called the "Frijadrive," it is the first twin-turbine system to combine the functions of a bleed air drive turbine and an air cycle machine.

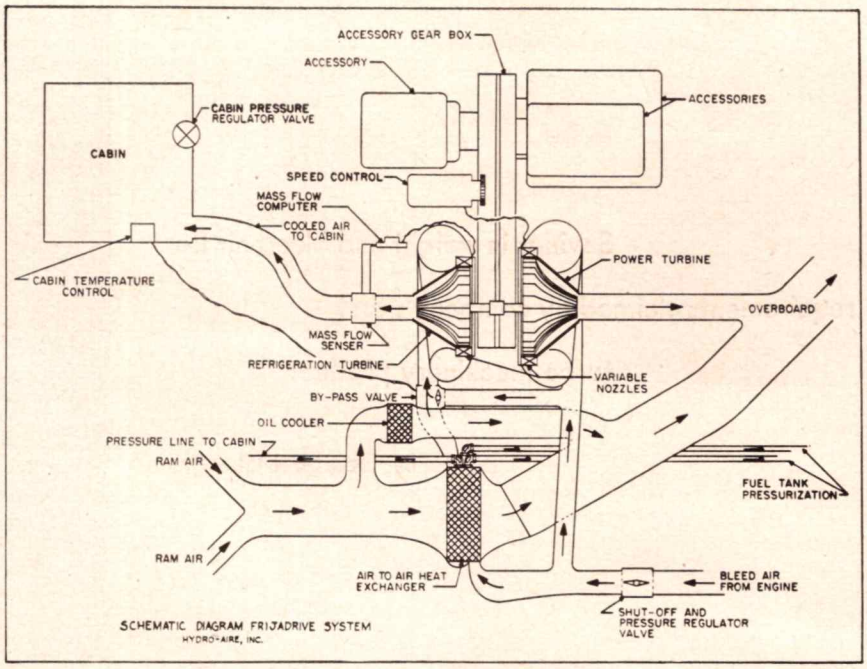
It serves the two purposes of air conditioning and of supplying a steady source of accessory-drive power.

By combining these functions into a single package, the Frijadrive offers weight savings of 20 to 40 percent. It also offers savings in bleed air flow requirements up to 50 percent.

The Frijadrive supplies air conditioning with the same bleed air that is used for accessory-drive power. The system consists of two turbines mounted on a single shaft, a gear box, heat exchanger and controls. One turbine is used to cool the required amounts of bleed air for cabin conditioning and equipment cooling. The energy extracted in this process is used to drive the plane's accessories.

The other turbine develops any additional power required by the driven accessories. This second turbine also acts as a brake when energy developed by the cold turbine exceeds the power required for accessory drive. Thus, the unit is designed to operate at constant speed, regulated by variable nozzles in the power turbine. Variable nozzles in the cooling turbine provide the necessary modulation of bleed air to meet cooling and pressurization requirements. The control system is capable of providing a constant speed within .2 of one percent.

The system can satisfy rigid cabin temperature requirements for a large range of inlet conditions, at the same time developing the shaft power at constant speed in accordance with constant or variable load requirements.



Schematic diagram shows complete flow

Control system of the "Frijadrive" consists primarily of a bleed air pressure regulating inlet valve, a temperature control bypass valve, a mass-flow computer actuating the refrigeration turbine nozzles, and a speed control which regulates the power turbine nozzles. The nozzle vane control of the power turbine is arranged to act as a brake in cases where the accessory power requirement is not sufficient to meet the refrigeration demand.

The cooling turbine wheel is a high-performance radial flow design made of forged high strength aluminum alloy. The scroll is of the low velocity type. Variable nozzles are airfoil type profiles and are supported on individual bearings for maximum reliability.

The power turbine wheel is also a high performance radial flow design. This wheel is made of forged stainless steel. Scroll and variable nozzle designs are similar to the cooling turbine, but adapted to higher temperature levels.

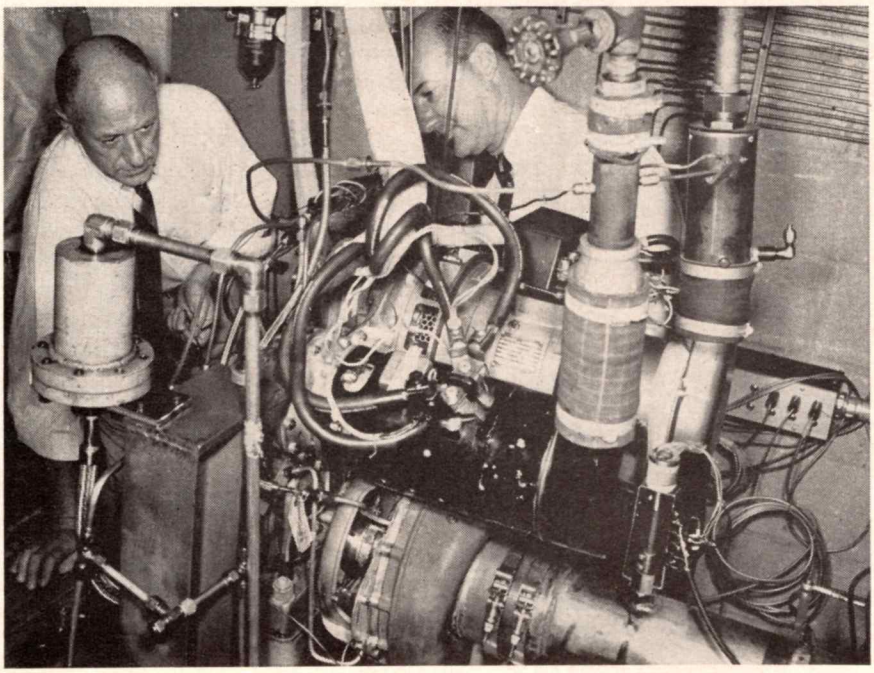
Compressed air is bled off the engine to supply power for the system. This air is split into two ducts: One duct system directs the air through and/or around the heat exchanger, then through the cooling turbine and into the cabin. The other duct directs the air into the power turbine.

Heat taken out in the heat exchanger is given to the ram air that passes through the heat exchanger. This ram air goes overboard. The bleed air coming out of the heat exchanger is still too hot for air conditioning. By expanding the air through the cold turbine, energy is removed, thus lowering the temperature. This energy in turn is used to drive the accessories. The control system then regulates the additional power required from the other turbine, or—if there is excess energy — causes the other turbine to act as a brake. If cabin temperature drops below the desired level, the bypass valve automatically—or at the pilot's discretion—routes a portion of the air past the heat exchanger. By this method cabin temperature control is accomplished.

The first Frijadrive package so far developed provides an air-conditioning flow controllable from 30 to 60 lb. per minute while handling loads from zero to 80 hp.

END

Dale A. Lichty, Hydro-Aire Vice President and Ted Scott, turbine engineer, inspect "Frijadrive" prototype



AERO DIGEST design forum WINNERS

DECEMBER, 1954 CONTEST

Kenneth E. Hodge (right) receives last month's first prize check from George McLaughlin, AERO DIGEST Senior Editor

THE December Aero Digest Design Forum marks the end of five monthly contests in which $2375 has been given to winners across the country. The Board of Editors judged from hundreds of entries which contained ideas ranging from the design of a single bolt to the plans for an external fuel tank ejection system. Designs were judged on the degree to which they improved flight safety, reduced airplane complexity, and provided a manufacturing cost saving through engineering judgment and the application of technical skill.

The purpose of the Forum was to give industry-wide recognition to the research, design, engineering and production achievements of today, and to encourage and foster even more brilliant achievements in this industry's great future. To this end, the Forum was even more successful than we imagined it would be. Every month saw more and more entries coming in, and the judges finding it increasingly difficult to determine the winners. In several cases, patents were applied for by the contestants; in others, we were informed that company prizes were awarded to Aero Digest winners. Thus, besides the cash value of the awards, the winners received professional recognition for their work and the corresponding encouragement.

The grand prizes will be announced in the February issue of Aero Digest. First prize is $1000. Second prize, $750. Third prize, $500. Three honorable mentions, $125 each. All entries, regardless of when received or whether or not they have won a monthly award, will qualify for the grand prizes if they were postmarked on or before midnight, December 1, 1954.

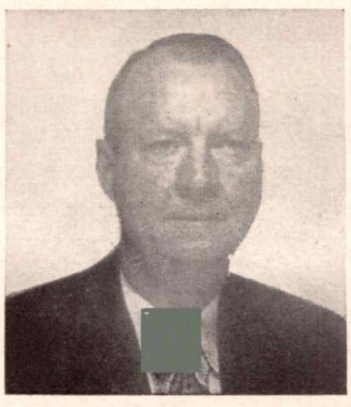
The three winners this month are all Westerners, two from California and one from Arizona.

First prize goes to Alfred E. Blatter of San Diego, Calif. Mr. Blatter, Machine Designer at Rohr Aircraft Corp. of Chula Vista, submitted the drawings for a device to facilitate the bending of magnesium sheets in press brakes without producing scratches. In addition, his device eliminated the possibility of the magnesium galling on the radii of the brake die.

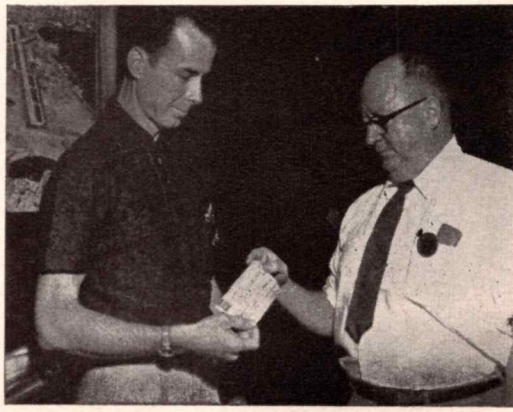
To accomplish the bending of the magnesium without scratching its surfaces. Mr. Blatter permits the sheets to roll free into the die by permitting feeding rollers to rotate with the materials as it is being drawn down into the die. In this fashion rubbing action on the material is reduced to practically zero together with the marring of the surface.

In view of the recent conclusions of the British Board of Inquiry looking into the cause of failure of the *Comets,* the fabrication of structures with scratch-free surfaces is of prime importance. It is at a scratched surface that stress concen-

Second prize winner, W. W. Farr



David Merritt (left) receives third prize check from A. P. Higgins



trations build up leading to a reduction of fatigue stress allowables and an increase in structure failures.

The second prize of $125 goes to Mr. S. E. Black, Stress Engineer, Hughes Aircraft-Missile Division, Tucson, Arizona. His design for a pneumatic duct support bracket simplifies present methods and eases fabrication.

Some present designs for duct supports have the ducts clamped to a bracket while movement is taken by pivots in the bracket. These brackets are usually heavy castings in order to hold these pivots. There have been cases of failure of a hot air duct where retraining supports prevented it from expanding.

Another design uses rigid clamp support brackets with all expansion being taken out by the duct bellows. This design often proves unsatisfactory because of wing flexure. The problem can be solved by cutting the length of ducts and incorporating more bellows.

Mr. Black's design permits longitudinal movement (spanwise) of the duct but prevents horizontal (chordwise) and vertical movements. Longitudinal restraint should not be prevented because of thermal expansion and wing flexure; however, horizontal and vertical movements, which result from pressure within the duct, must be prevented. The design uses roller bearings for this purpose. The brackets tie directly into the front wing spar.

Mr. Black's design is not intended to replace duct bellows, which must be used in any system but rather to present a support for long lengths of ducts, prevent undesirable restraint, and to eliminate extra sections of bellows which are expensive and troublesome.

Hugh McDaniel, Sub-assembly and Structure Project, Douglas Aircraft Co., Santa Monica, Calif., wins the third prize of $100. Through his development of his *Hole Saw* he has provided a manufacturing cost saving through the application of technical skill. Mr. McDaniel noted that with the old type hole saw, when used to cut through 75ST aluminum or 24ST, there was an appreciable build up of material resulting in clogging of the teeth and appreciable captured heat. These conditions led to increased pressure on the drill shaft for adequate cutting together with frequent resharpening of the hole saw. By eliminating three to five teeth of the hole saw, the number depending on the tool's diameter, and on the remaining teeth setting the cutting edge 15 percent down on its inside radius, Mr. McDaniel was able to lick the heat build up problem from two angles: 1) he provided more volume for the escape of material, and 2) the saw cut through the material so quickly that there was barely time to build up much of a heat load. Furthermore, far less pressure was now required on the drill shaft.

The grand prize winners will receive in February a total of $2625, bringing the total value of prizes to $5000.

All entries will be considered for awards for the grand prizes. The decision of the judges shall be final.

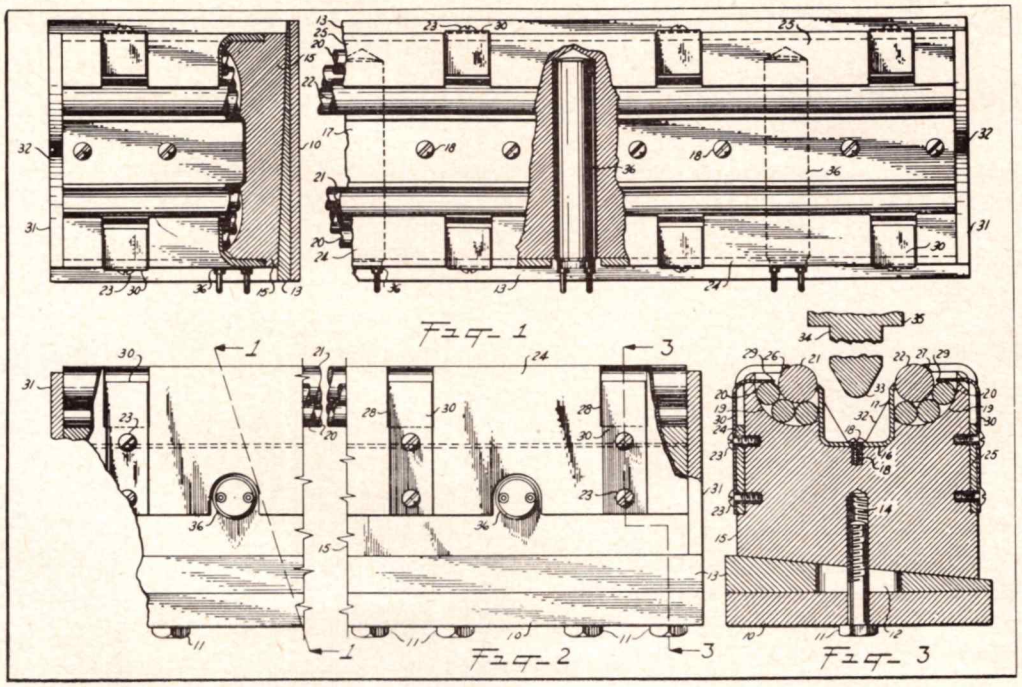
END

First Prize • $250.00

MAGNESIUM BENDING WITHOUT SCRATCHING

Alfred E. Blatter

Machine Designer
Rohr Aircraft Co.
Chula Vista, Calif.

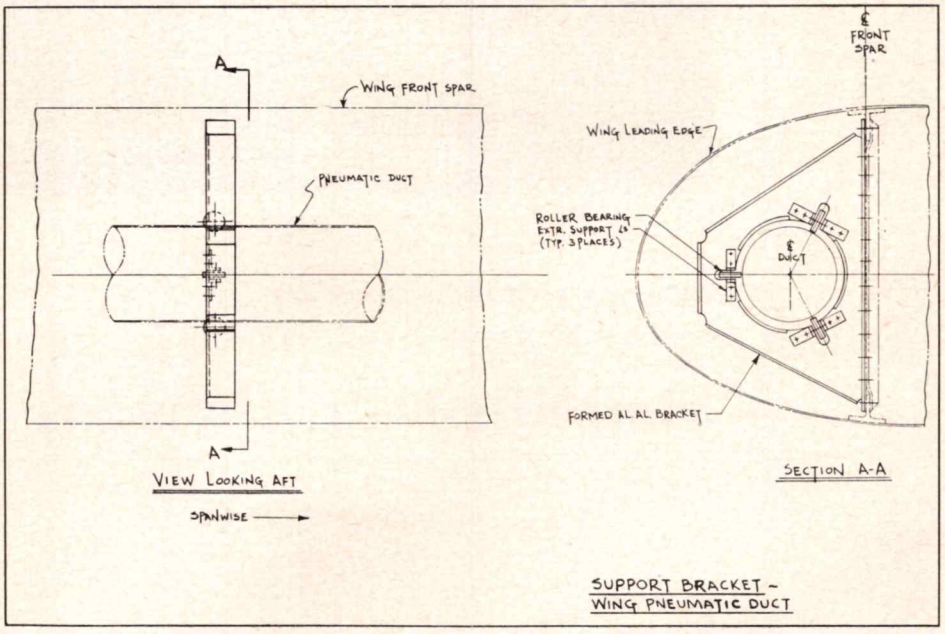


PNEUMATIC DUCT SUPPORT

Second Prize • $125.00

S. E. Black

Stress Engineer
Hughes Aircraft Missile Div.
Tucson, Ariz.

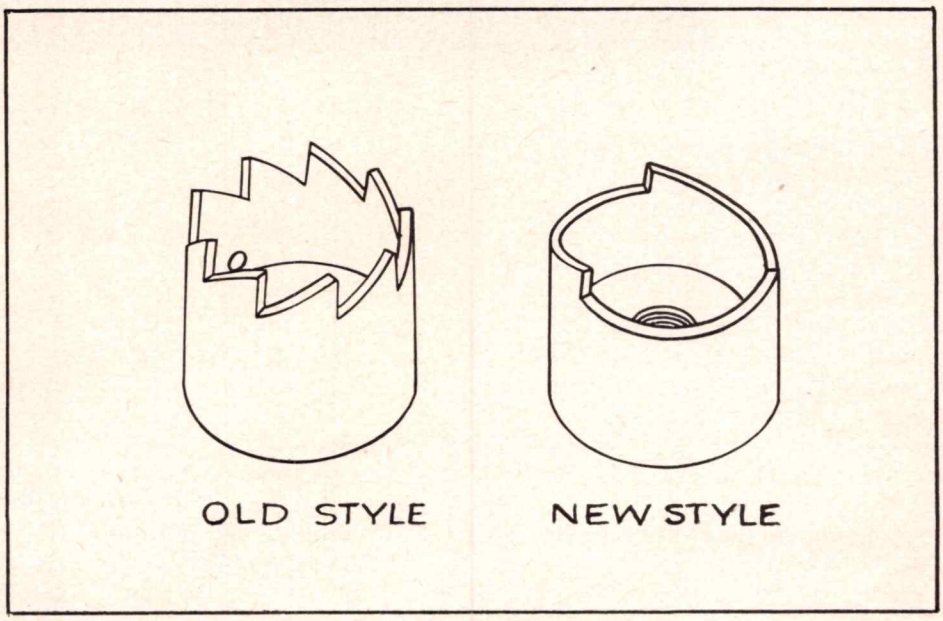


HOLE SAW

Third Prize • $100.00

Hugh McDaniel

Douglas Aircraft Co.
Santa Monica, Calif.



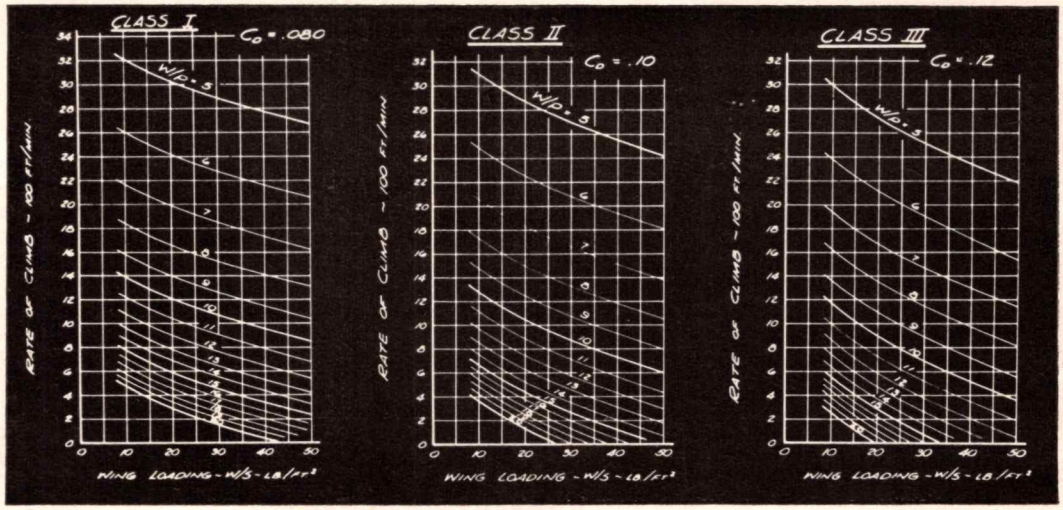


Fig. 1

Curves as shortcuts for predicting basic aircraft performance data

Simplified Performance Prediction

By KEN S. HOWARD

Senior Flight Test Engineer,
Consolidated Vultee Aircraft Corp.

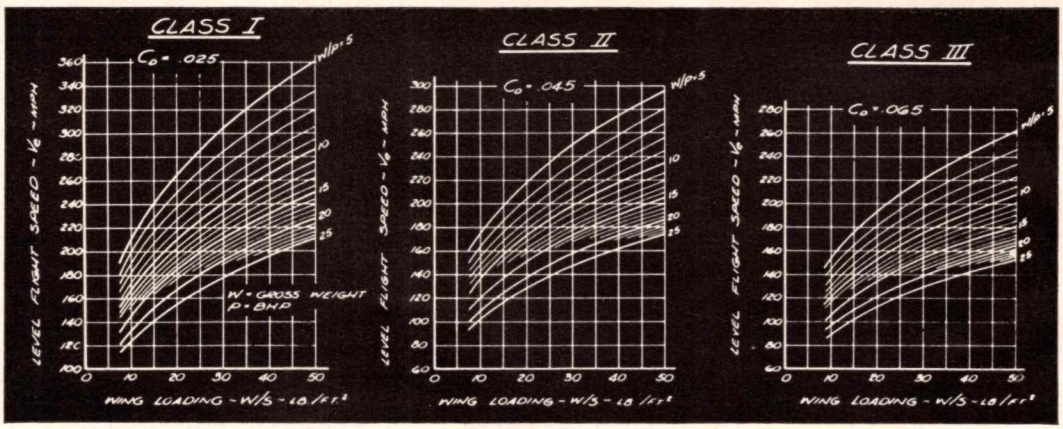


Fig. 2

THE following presents a simple and rapid means for predicting airplane rate of climb and level flight speed performance using the three basic performance parameters—wing loading, power loading, and drag characteristics. The method is applicable to all types of reciprocating engine airplanes from *Cubs* to *Convair Liners*. Experience in its use has indicated that this means is valuable for rapidly and simply:

1. Predicting airplane performance in the preliminary design stage.
2. Finding the effect of the following for existing designs:
   (a) Changing gross weight
   (b) Changing the power plant, or simply changing power
   (c) Changing propellers
   (d) Changing altitude
   (e) Changing the drag characteristics, wing area, aspect ratio, etc.

This method is intended to be useful to the layman aircraft owner and operator as well as for the engineer. The heart of the solution to the performance problem lies in a set of curves.

The terms used are as follows:

W = airplane gross weight in pounds.
S = airplane total wing area (including part through fuselage) in square feet.
P = airplane total rated horsepower.
AR = airplane aspect ratio = b^2/S.
b = wing span in feet.

This analysis segregates airplanes into three classes—Class I, II, and III depending on how "clean" they are from a drag standpoint. Examples on next page.

Class I: Retractable landing gear, cantilever surfaces, generally quite clean — Aero Commander, Ryan *Navion,* Bellanca *Cruisemaster.*

Class II: Fixed "clean" gear, cantilever tail, single strut or cantilever wing, only small protuberences — Beecraft *Honeybee,* Cessna 170 and 180, Luscombe *Silvaire.*

Class III: Fixed braced gear, all surfaces braced, general proturberences—Piper PA-18 *Cub,* Taylorcraft two-place Aeronca *Champ.*

The use of this method can best be shown by examples. The first is as follows:

Example I:

1. Find the rate of climb for an airplane having:
   (a) fixed pitch, wood propeller
   (b) altitude—sea level
   (c) full cantilever surfaces and fixed "clean" gear
   (d) W = 800 lb.
   (e) S = 100 sq. ft.
   (f) P = 65 bhp
   (g) b = 26.5 ft.

2. Compute:
   (a) $AR = b^2/S = 26.5^2/100 = 7.0$
   (b) $W/S = 800/100 = 8.0$
   (c) $W/P = 800/65 = 12.3$

3. Answer:
   Enter Fig. I (center set of curves for Class II) with W/S = 8.0 and proceeding up to W/P = 12.3, read the rate of climb from the scale at the left as 1000 ft./min.

Example II:

1. Find the maximum speed of the airplane described above:
2. Enter Fig. 2 (center set of curves from Class II) with W/S = 8.0 and proceeding up to W/P = 12.3, read the maximum speed from the scale at the left as 120 mph.

The foregoing examples, the simplest, were chosen first because they illustrate the ease with which this method can be used for the airplane configuration for which the curves were developed—a conventional lightplane flying at sea level. This method is not limited to these conditions, however, as the following examples illustrate:

Example III:

1. Find the rate of climb for an airplane having:
   (a) constant speed metal propeller
   (b) altitude—2500 ft.
   (c) full cantilever surfaces and retractable landing gear
   (d) W = 2700 lb.
   (e) S = 178 sq. ft.
   (f) P = 205 bhp
   (g) b = 32.8 ft.
2. Compute:
   (a) $AR = b^2/S = 32.8^2/178 = 6.04$
   (b) $W/S = 2700/178 = 15.2$
   (c) $W/P = 2700/205 = 13.2$
3. Find from the curves:
   (a) $k_1 = 1.04$ from Fig. 3
   (b) $k_2 = 1.09$ from Fig. 4
   (c) $k_3 = 1.08$ from Fig. 5
   (d) $\sqrt{W/S} = 3.9$ from Fig. 6
4. Compute
   (a) Multiply W/P by k_2, and by 0.75 from a constant speed propeller, giving $(13.2) \times (0.75) \times (1.09) = 10.8$
   (b) Multiply W/S by k_1 and k_3, giving $(3.9) \times (1.04) \times (1.08) = 4.39$
   (c) Find W/S from Fig. 6 using (b) above, giving W/S = 19
5. Answer:
   Enter Fig. 1 (1st set of curves for Class I) with W/S = 19 of (c) above and W/P = 10.8 of (a) above, Rate of climb = 1100 ft./min.

Example IV:

1. Find the maximum speed of the airplane described above:
2. Compute: Multiply W/P by k_1 and k_2, giving $(13.2) \times (1.04) \times (1.09) = 15$
3. Answer: Enter Fig. 2 (1st set of curves for Class I) with W/S = 15.2 of 2(b) and W/P = 15 of (a) above, and find the maximum speed as 169 mph indicated.

In using the rate of climb curves, it is assumed that:

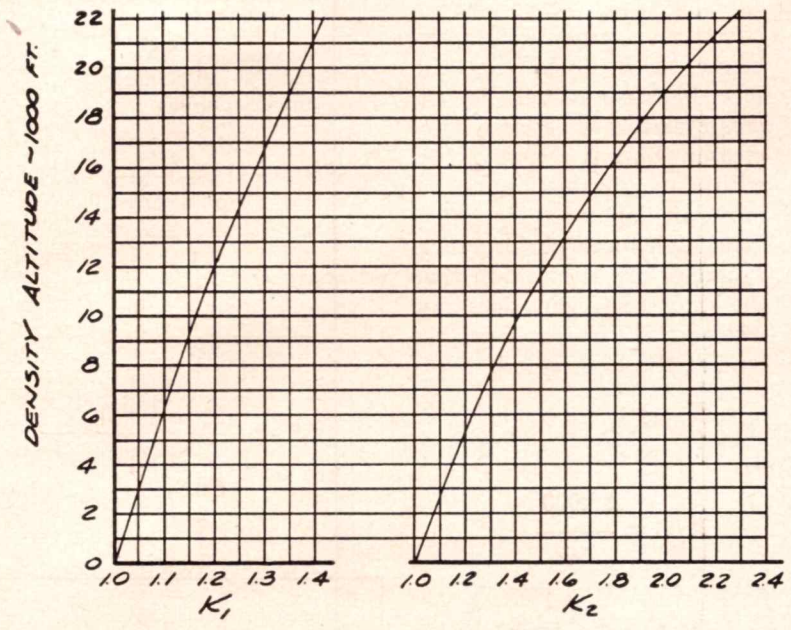


Fig. 3 Fig. 4

1. The climb is made at a lift coefficient of 1.0. For most conventional airplanes, the speed for best rate of climb is the speed for which the lift coefficient equals approximately 1.0.
2. The propeller used is a fixed pitch wood propeller. For a constant speed or controllable pitch propeller which permits rated rpm during the climb, the power loading must be multiplied by 0.75 to obtain

an effective power loading for the climb curves. This 0.75 factor is used only for the climb curves and not for the level flight speed because it is assumed that rated rpm can be obtained in level flight with the fixed pitch propeller. If desired, a further refinement can be used for a metal propeller in place of a wood propeller by multiplying the power loading by 0.95 before entering the curves.

In using the level flight curves, the following should be noted:

1. The level flight speed given on the curves is *equivalent* airspeed, which is *indicated* airspeed corrected for compressibility. For light planes, speeds and altitudes are low enough that equivalent airspeed and indicated airspeed are the same.
2. In using the curves to find the effect of a gross weight increase, it is noted that the level flight speed will not decrease as the gross weight increases. This is actually true, within measurable limits, for most airplanes having fairly good high speed performance. It makes the assumption that the drag coefficient does not change, which is reasonably true at the high speed.

Derivation of Climb Performance Curves:

$$R/C = \frac{33{,}000}{W}\left(\frac{C_D V_e^3 \sqrt{\frac{1}{\sigma}}\, S}{146{,}600} - BHP\eta_P\right)$$

algebraic rearrangement:

$$R/C = \frac{33{,}000}{W}\left(\frac{W\eta_P}{W/P} - \frac{C_{D_T} V_e^3 W \sqrt{\frac{1}{\sigma}}}{(146{,}600)W/S}\right)$$

$$V_e = \sqrt{\frac{(391)(W/S)}{C_L}}$$

$$R/C = 33{,}000\left[\frac{\eta_P}{W/P} - \frac{C_{D_T}(391)^{3/2}(W/S)^{3/2}\sqrt{\frac{1}{\sigma}}}{C_L^{3/2}(146{,}600)(W/S)}\right]$$

$$R/C = 33{,}000\left[\frac{\eta_P}{W/P} - \frac{C_{D_T}(W/S)^{1/2}\sqrt{\frac{1}{\sigma}}}{C_L^{3/2}(19.05)}\right]$$

For Climb at $C_L = 1.0$,

$$R/C = 33{,}000\left[\frac{\eta_P}{W/P} - \frac{C_D (W/S)^{1/2}\sqrt{\frac{1}{\sigma}}}{19.05}\right]$$

Similarly, angle of climb

$$= \mathrm{Sin}^{-1}\left[\frac{19\eta_P}{(W/P)\sqrt{\frac{1}{\sigma}}\,(W/S)^{1/2}} - C_D\right]$$

Derivation of Level Flight Performance Curves

$$THP = \frac{TV_T}{375} = \frac{DV_T}{375} = BHP\eta_P$$

$$\frac{C_D V_e^2 V_e \sqrt{\frac{1}{\sigma}}\, S}{(391)(375)} = BHP\eta_P$$

$$V_e^3 = \frac{BHP\eta\,(146{,}600)}{C_D S\sqrt{\frac{1}{\sigma}}}$$

Algebraic re-arrangement

$$V_e^3 = \frac{(W/S)\eta_P\,(146{,}600)}{C_D\,(W/P)\sqrt{\frac{1}{\sigma}}}$$

The constant k_1 is simply $\sqrt{\frac{1}{\sigma}}$. The constant k_2 is the inverse of the full throttle variation of BHP with altitude. The factor k_3 requires some explanation. It has been determined that approximately 50 percent of the airplane drag at $C_L = 1.0$ is induced drag. Assuming that the induced drag coefficient varies directly with aspect ratio, then the expression $\frac{2}{1 + AR/7}$ which, when multiplied by $\sqrt{W/S}$ will yield the effect of variation in aspect ratio from 7.0.

It should be pointed out that the curves presented here are valid for conventional aircraft in which the general proportions (for example the ratio of frontal area to wing area) are conventional.

It should be emphasized that the foregoing method is not intended to replace or even supplement the use of the classical methods of performance determination, but can be useful for rapid performance estimation where it is realized that the generalizations used in the development of the method introduce small errors which, for the purpose intended, can be tolerated. END

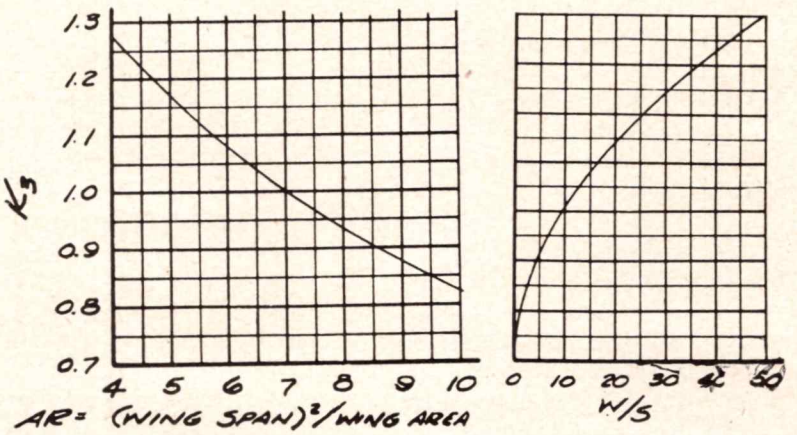
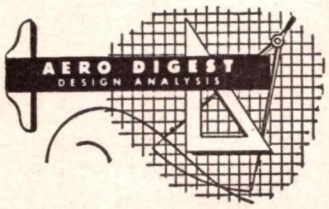
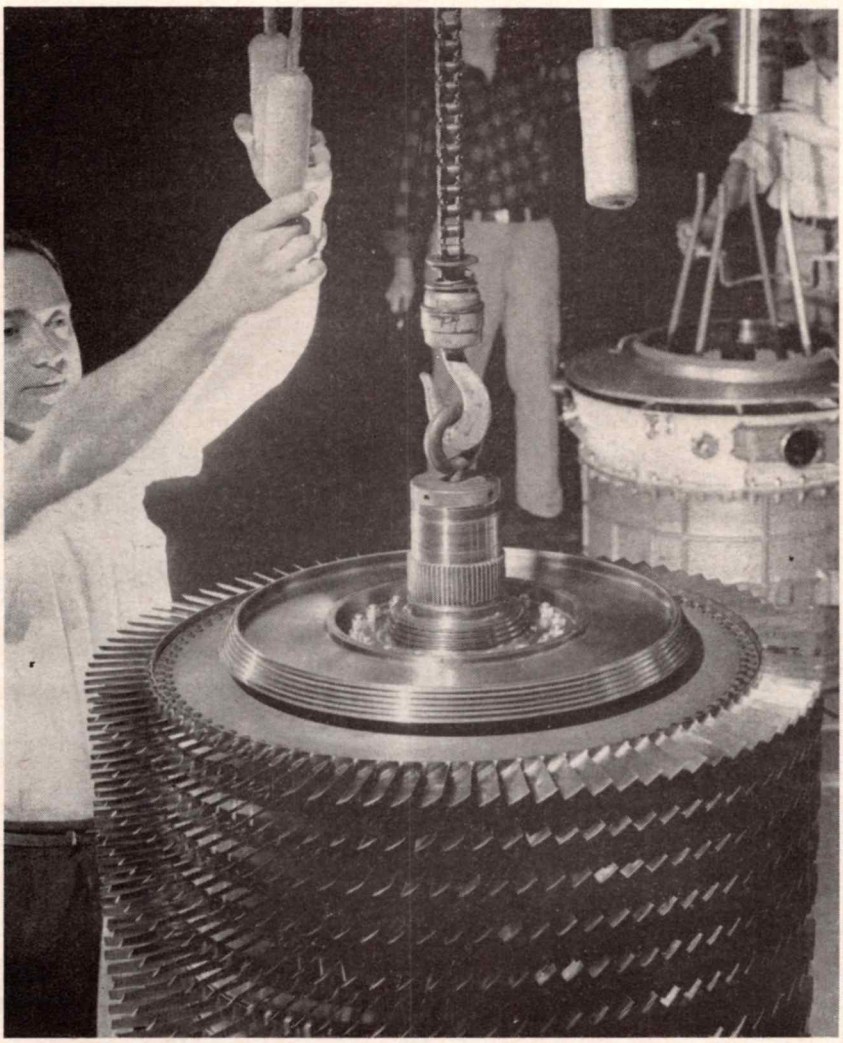


Fig. 5 Fig. 6



Continued development of versatile engine will add to record making installations



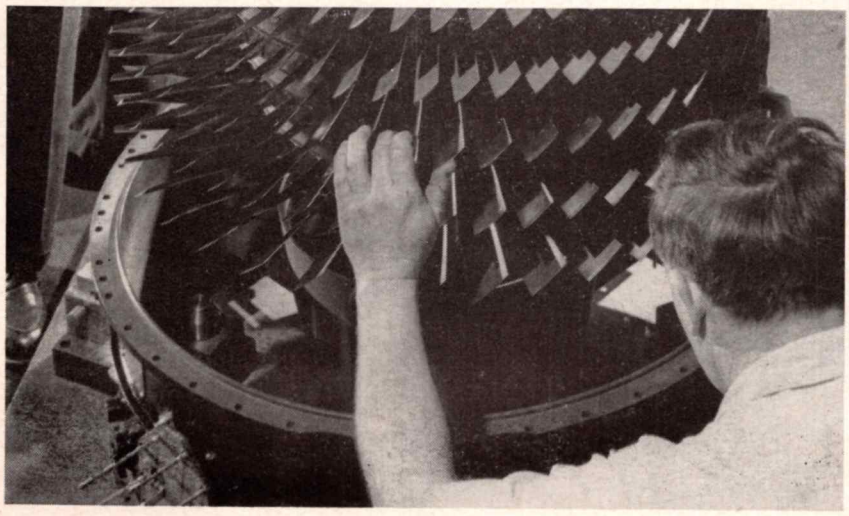
CURTISS-WRIGHT J65

THE Curtiss-Wright J65 now leads all other U. S. turbojet engines in the number of high-performance tactical aircraft types for which it has been selected. And concurrently with the disclosure that advanced models of the engine are in production at 7800 pounds and with afterburner, development of the J65's growth potential is continuing.

Recent announcement of this country's four very latest military models—the bantam Douglas A4D *Skyhawk*, the Lockheed F-104 high-speed day fighter, the Grumman F9F-9 *Tiger* supersonic fighter, and the North American FJ-4—brings to seven the number of top-rank tactical craft which the J-65 powers. There are additional installations still to be revealed when security permits.

Since an F-84F fighter-bomber, winner of the 1954 Bendix transcontinental speed race, first flew with a J65, this engine built by Curtiss-Wright has also been installed in the RF84 *Thunderflash* reconnaissance fighter, the Martin B-57 twin-jet *Night Intruder* bomber, and the North American FJ-3 *Fury* shipboard fighter.

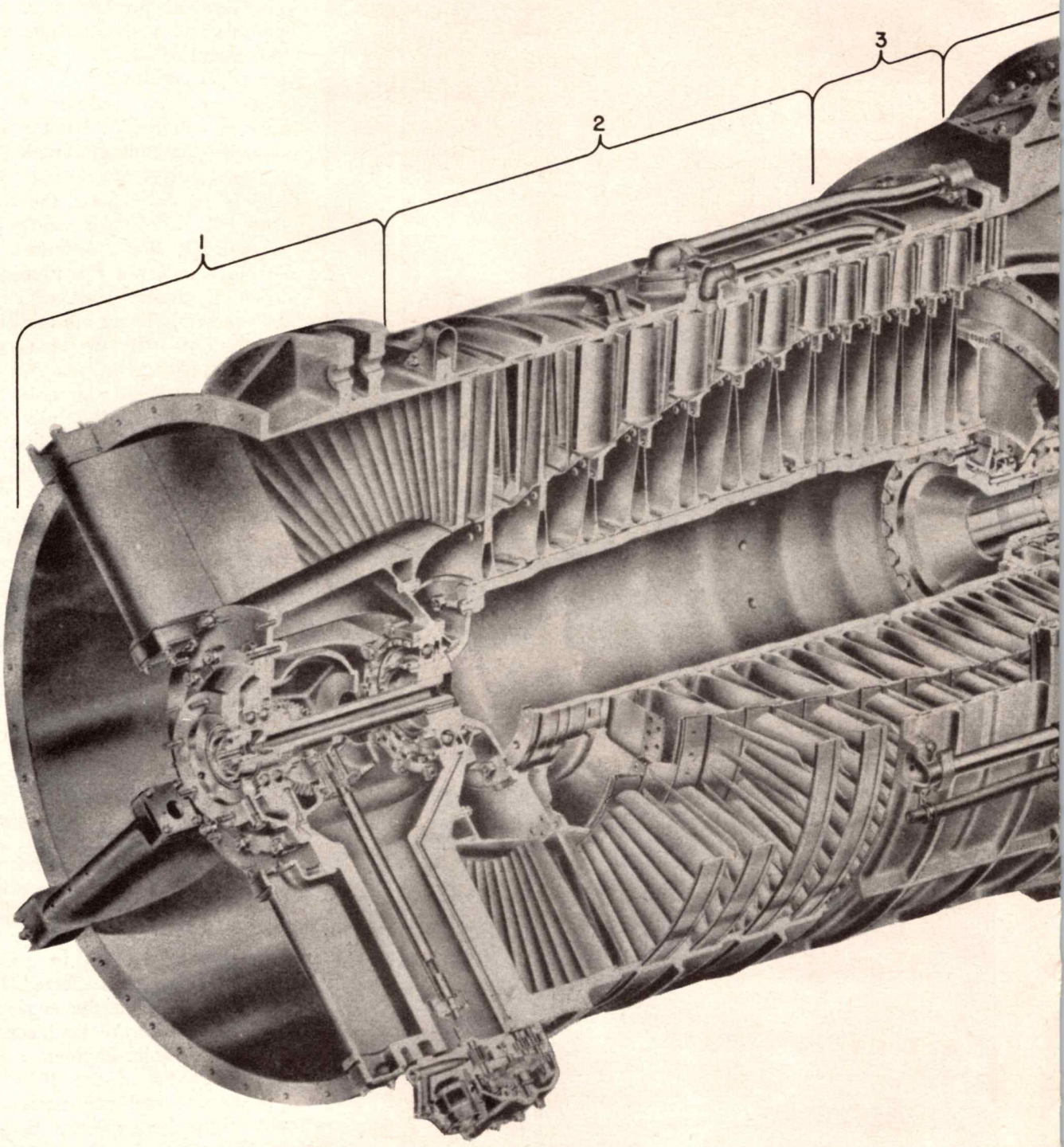
The J65 engine has been cited for its economy as well as for its efficiency. Its fuel consumption has been as much as six percent below specification while its performance has regularly exceeded the original guaranteed rating of 7220 lb. of thrust.

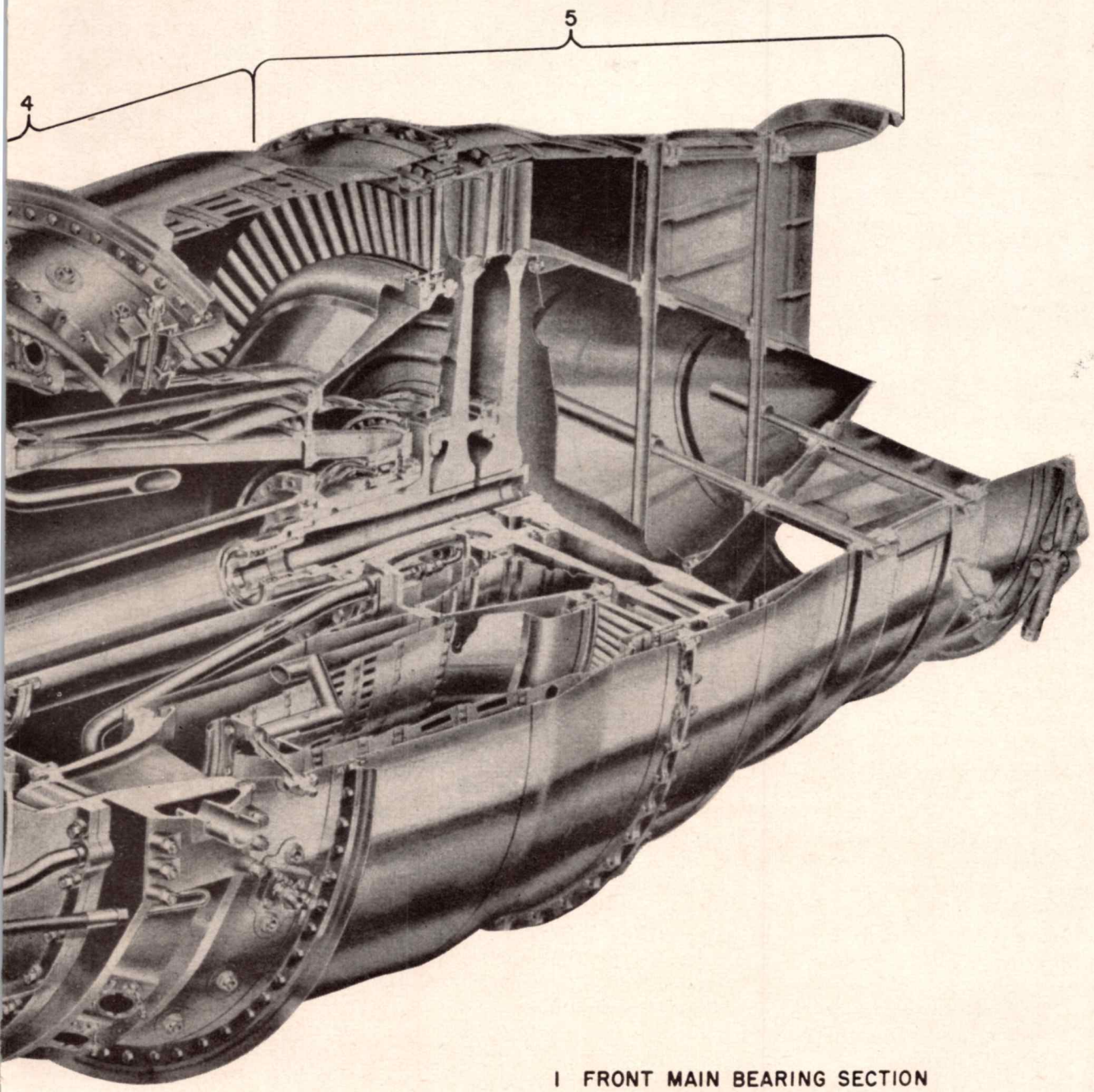


Important savings in strategic material have been effected in the J65. In addition, the engines fly without the smoke trail common to most turbojet engines.

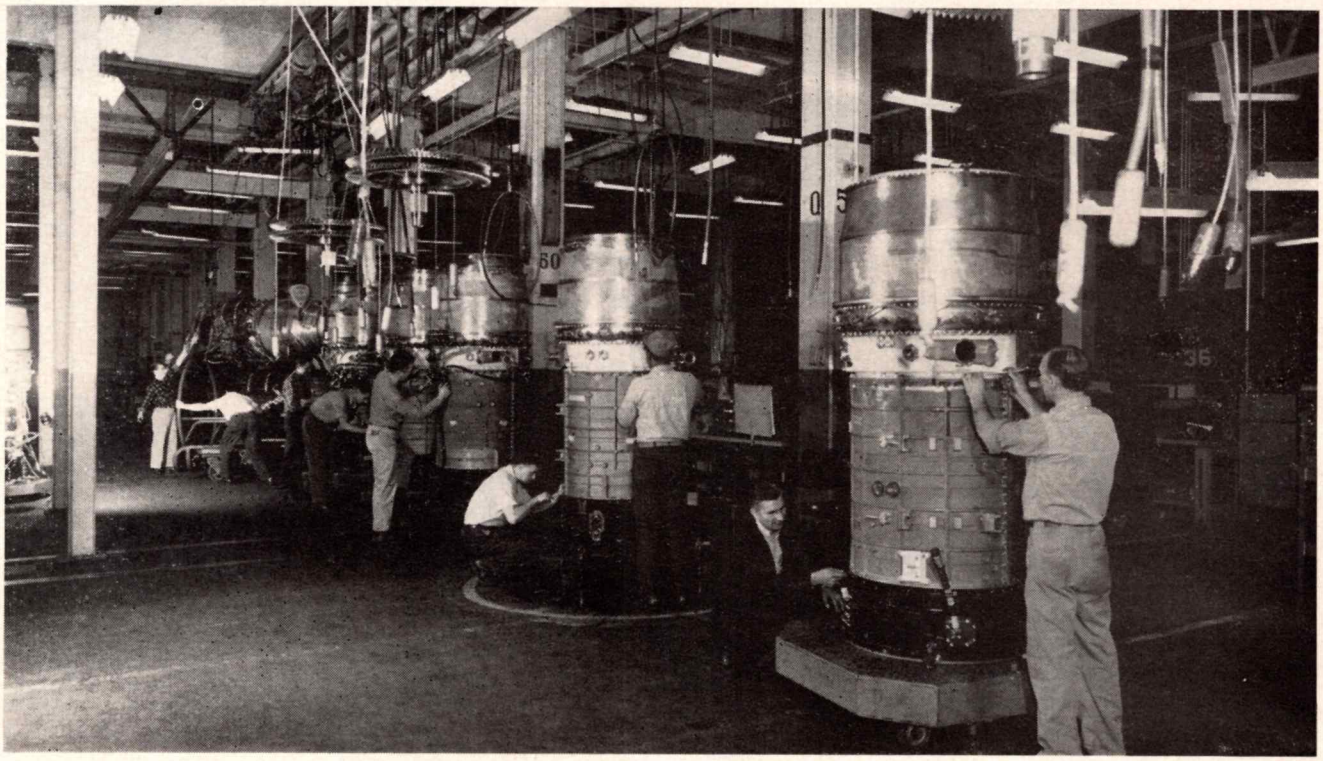
The design of the J65's compressor and fuel management system gives the engine a large air handling capacity per square foot of frontal area and an unusually

CURTISS-WRIGHT J65





1 FRONT MAIN BEARING SECTION
2 COMPRESSOR SECTION
3 CENTER MAIN BEARING SECTION
4 COMBUSTION SECTION
5 REAR MAIN BEARING, TURBINE AND EXHAUST SECTIONS



Vertical assembly technique facilitates production on these J65s which will soon be placed horizontal for final touches

high combustion efficiency. The front main bearing support forms an annular entrance to the compressor section and is supported by four hollow steel struts. These extend radially from the hub, 90 deg. apart, covered with four fairings to form leading edges. The front main bearing is housed at the rear of the support.

The compressor section, of lightweight construction, contains 13 rows of blades.

The inner surface of the compressor housing is slotted to accommodate carrier rings used to hold inlet guide vanes and each row of stators. The rings are split to facilitate assembly in the compressor housing, and a riveted key in the end of each carrier ring segment prevents rotation of the assembly and the stator blades.

Stator blades are grooved at their base to fit into grooves in the carrier ring.

Inlet or guide vanes and the first seven rows of stators are shrouded at their inner ends. These stators have lugs which fit into rectangular holes in the shroud pieces, and the blades are brazed to the shrouds.

Air from the final compressor stage passes through two straightening vanes which remove the tangential component of compressor flow. From the two straightening vanes the air enters the diffuser.

The diffuser section is integral with the center main bearing support housing. Located about midway in the engine, the support is a key part of the engine structure. Two trunions attached to it carry almost the entire weight of the engine and absorb the maneuver loads encountered during flight. The support also houses the center roller bearing which carries the sub shaft bolted to the main compressor shaft.

Once machined from a single aluminum forging, the center main bearing support is now made—at one-fifth the original cost—from two precision nodular cast iron sections joined by ten stainless steel struts welded into place. Substitution of the nodular iron and stainless material has made the present center main bearing support superior to its non-ferrous predecessor in strength and resistance to heat.

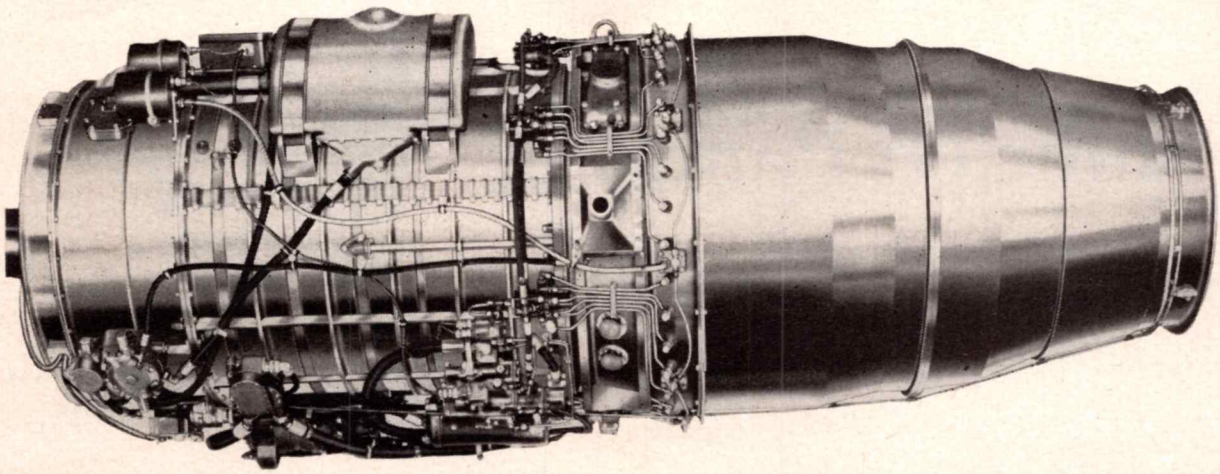
The combustion chamber is of the annular type. The entire combustion section is comprised of the inlet housing, the combustion chamber housing, outer liner, inner liner, heat shield, rear main bearing cone, and the burner support on which the primary air-and-fuel tubes and secondary air distributing cups are mounted.

The vaporizing system used in the J65 is basically different than that used in most other U. S. turbojets. Fuel is mixed by vaporization only. There is no mixing of fuel and air by mechanical atomization with spray nozzles or other orifices.

The turbine section is a two-stage unit. First stage stator blades are bolted to a stator inlet ring and second stator blade support. Tips of first stage stator are held in a blade support ring. This support ring is located on the rear end of the first stage stator blade support assembly, which is attached to the rear flange of the rear main bearing support cone.

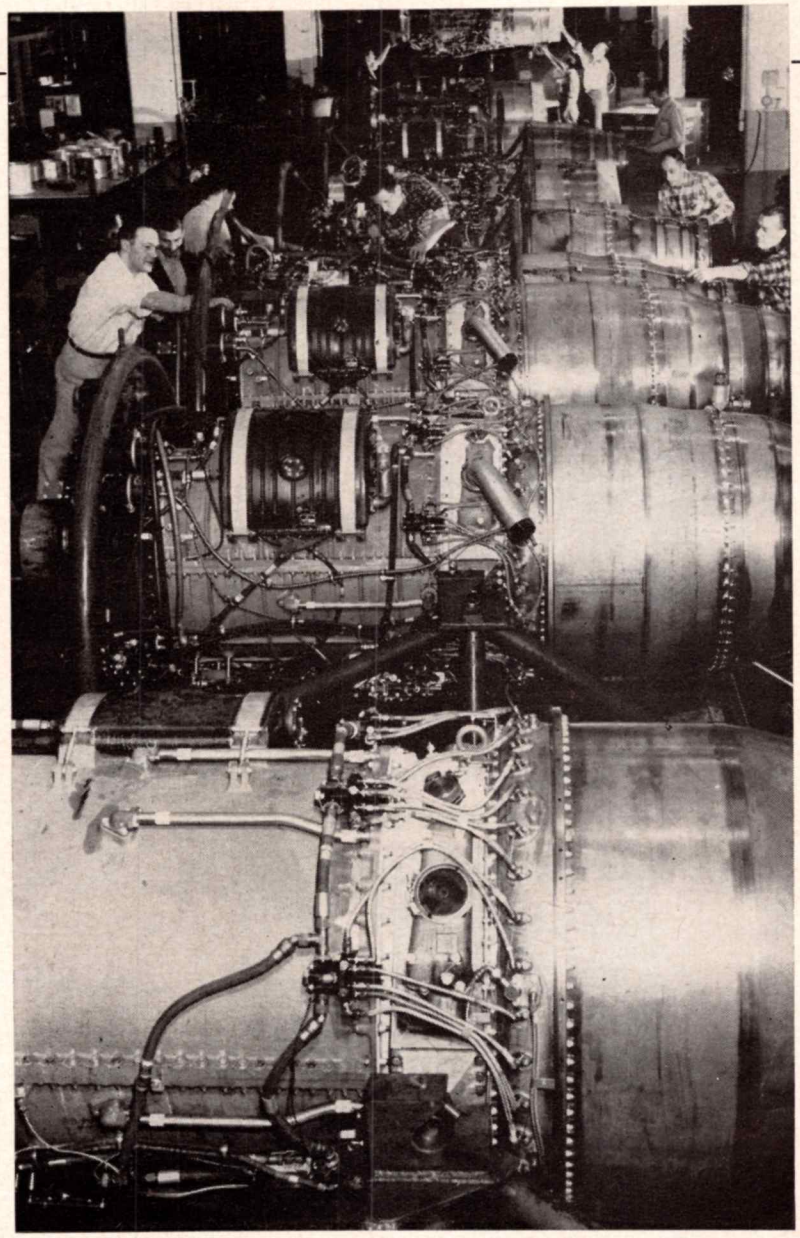
The engine oil tank is mounted near the top of the compressor housing and is supplied as an integral part of the engine. This feature simplifies development and installation problems associated with a suitable oil supply system.

In early J65 models a high-pressure fuel pump, a positive-displacement, multiple plunger type, was designed to run on aviation kerosene or gasoline, without lubrication. A built-in governor prevents engine overspeeding.



Completed engine ready for installation

Final assembly on J65



In the fuel system of later models, the booster pump is an engine-driven unit consisting of a centrifugal impeller pump on an integral shaft with a rotor vane type pump. An adjustable relief valve provides for pressure regulation.

Provision is made on the engine for installation of a fuel flow meter, if required.

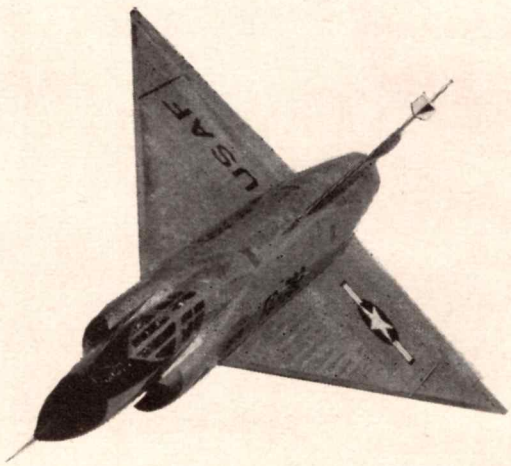
An engine fuel control uses a filter, acceleration control, throttling control, and pressurizing valve.

Electrical starter, primers, and ignition systems are all interconnected so that the start is automatic.

After the engine is running, the starter becomes the generator and the primers and ignition system are de-energized by a timing unit which permits them to operate for only 20 seconds. The starter is housed in a bullet fairing on the engine nose.

It is recognized that the J-65 has a fine growth potential that will lead to the achievement of greater thrust powers as development continues on the engine. There is a version of the engine with afterburner that has been officially announced as the powerplant of both the Grumman F9F-9 and the Lockheed F-104. END

Sandwich Panels for Wing Tips

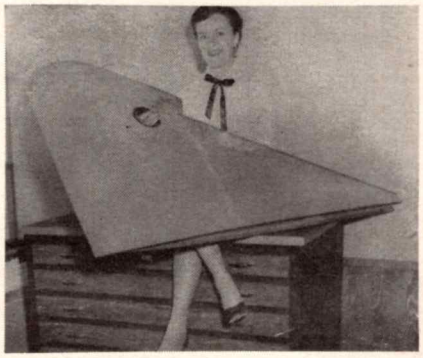


By HERMAN HOLLAND
Engineering Chief, Narmco Manufacturing Company

Low peel and shear strength tests passed by new adhesives in sandwich construction

Completed assembly ready for outer skin

Panel's light weight is outstanding feature



TESTS have proved metal sandwich component structures for airframes to be far more efficient and also 50 percent lighter than those of conventional design. For some time, the theoretical advantages of sandwich construction in aircraft and missiles have been recognized but U. S. Air Force tests on the F-80 wing reflected low peel and shear strength of the adhesives. More recent tests reveal how those difficulties have been overcome.

Development of a high-peel bond and methods for evaluating these bonds did much to further the cause for sandwich construction. With the advent of the new adhesives, Narmco Manufacturing Company set out in 1952 to establish that sandwich structures are a safe, economical and efficient method of producing primary structures.

The opportunity for proving the method came when the San Diego Division of Convair decided in favor of sandwich construction for its Delta wing-tip.

The ratio of the wing thickness to the length was very low, about

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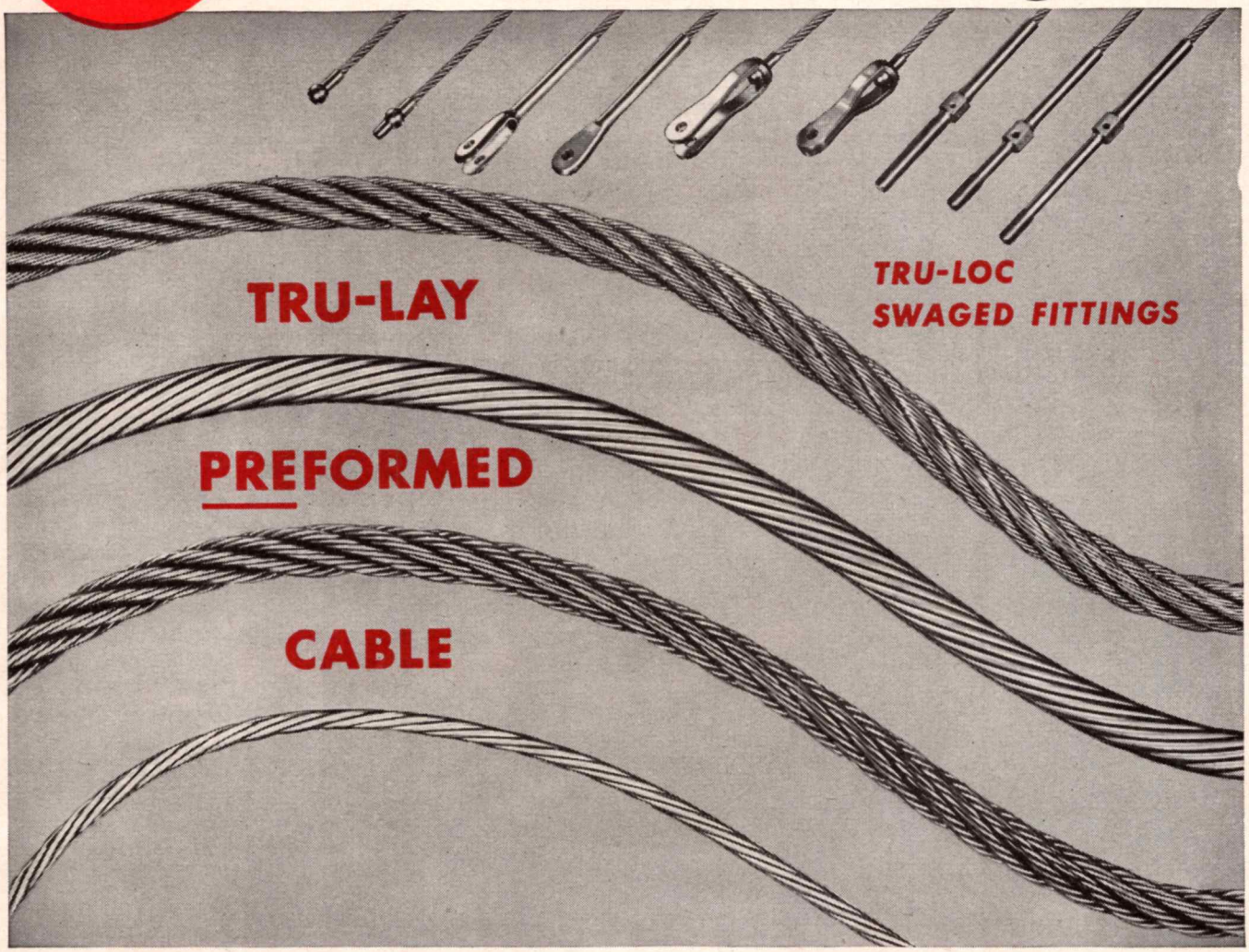

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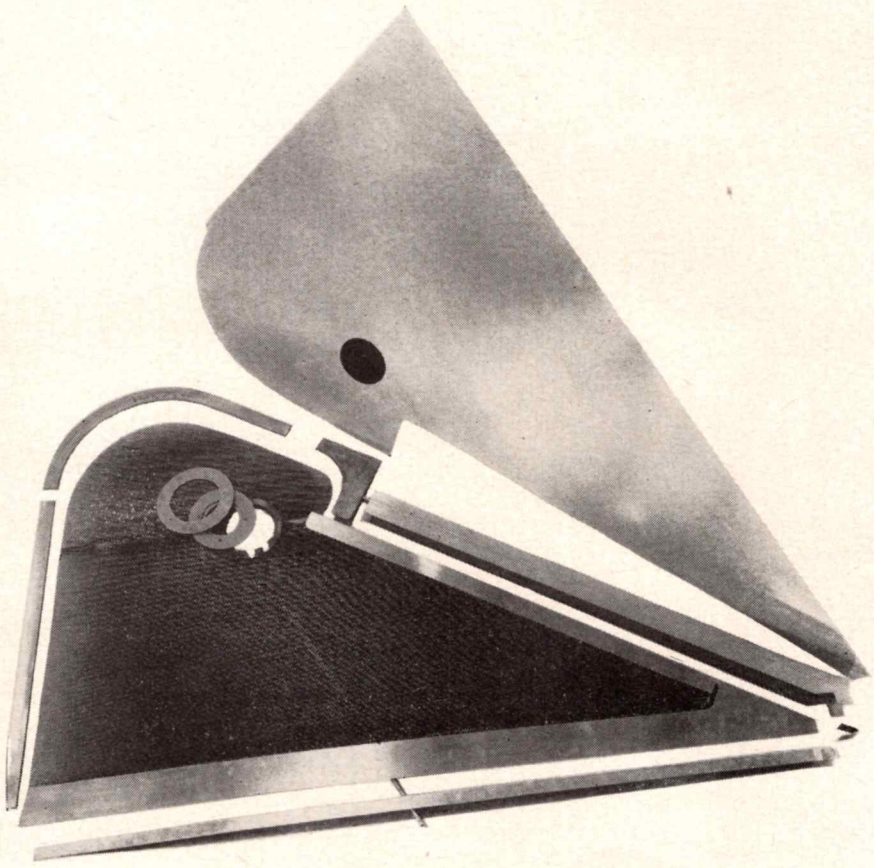
5 percent. The tip area wing thickness decreased so that with conventional design and fabrication it became a serious problem to achieve the necessary stiffness with such a thin structure. A conventional tip would have been inefficient weightwise.

A honeycomb metal sandwich was decided upon by the engineers because it would be rigid, light in weight and manufacturing problems would be reduced. Convair engineers produced a drawing of the tip showing its configuration and their conception of the core type and skin thickness. From that guide, Narmco was required to design the tip for production.

The procurement specification required a complete stress analysis, together with detailed drawings and process specifications. Included in the project was the static testing of three tips including long time cycling at 240 deg. F.

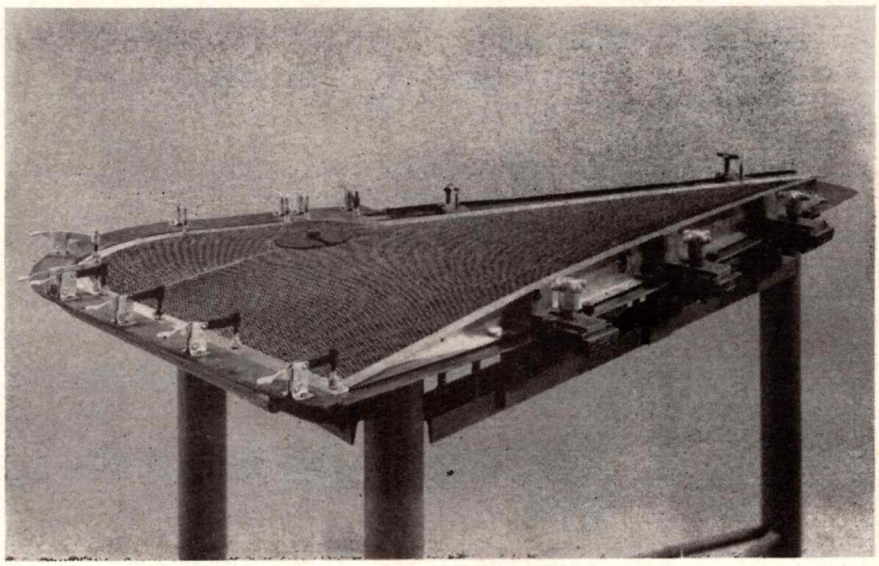
Several problems immediately became apparent. Specifications required that before actual tip fabrication could begin, certain materials making up the metal sandwich would have to be tested in order to qualify. The most critical material would be the adhesive used for the core to skin bond. Adhesives which would conform to Air Force specification No. 14164 ordinarily would have been considered. In this instance, however, skin temperatures well above 200 deg. F. were expected. Air Force specification No. 14164 required only 1250 psi tensile shear, at a maximum temperature of 180 deg. F. Convair's specifications required the adhesive to be capable of 1625 psi tensile shear strength while at 240 deg. F. The results of numerous tests conducted on several well established adhesives revealed none could qualify at 240 deg. F.

Fortunately, Narmco's research facility had just completed development of an experimental adhesive known as X127D. This adhesive passed all qualification tests. Air Force approval was granted without delay. Adhesive X127D was re-designated Metlbond 402 (unsupported tape) and Narmtape 103 (fiberglas supported tape).



Parts required in assembling sandwich construction wing tip

Sub-assembly fixture used for bonding various details to the contoured honeycomb core



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Methods for shaping metal honeycomb core had to be developed for this tip. Cores in the shape of wedges, flat sections, and other straight line elements have been fashioned in the past. The shaping of this core presented a problem, because the configuration called for faithful reproduction of a fully contoured airfoil shape. The core shaping problem was subsequently solved. All details and tools were completed and the first wing tip was successfully fabricated.

Meanwhile a load test fixture had been fabricated. With the wing tip mounted horizontally, loads could be applied by a single hydraulic jack, acting through a compression wiffle tree device, which was designed to resolve the single hydraulic jack force into several loads. These closely simulated the anticipated flight load conditions. Wing tip attachment to the test fixture was identical to that used on the airplane.

A total of sixty-four No. 1032 bolts were used, thirty-two at the top skin surface and thirty-two at the lower. The rows of bolts at each surface extended aft to approximately 50 percent of the chord. The remaining 50 percent was free. Instrumentation used to record deflections consisted of dial indicators linked to the wing tip by fine music wire.

Procurement specifications called for the following tests:

a. Wing tip No. 1 to be tested to destruction at ambient room temperatures. Deflection data to be taken at 500 lb. load increments up to design limit load. After each application, load to be removed and a check made for possible permanent set.

b. Wing tip No. 2 to be cycle tested to design limit load while at 240 deg. F. During each of the required 200 cycles, the design limit load to be applied and held for one minute. Load removed and wing tip allowed to cool to 125 deg. F. before repeating the next cycle. Deflection data to be taken at each cycle to determine possible permanent set. After completion of the required 200 cycles, the wing tip to be loaded to destruction.

When all preparations were complete, the testing of No. 1 wing tip began. As increasing loads were applied, and then removed, no permanent set was observed, nor did any permanent set occur after reaching 165 percent of design ultimate.

At this point the test fixture attachment failed in tension at the top surface bolt line. The fixture supports also had yielded, so it was difficult to believe permanent set had not occurred in the tip, although a close inspection showed no visual failure in bonds or skins. To make sure, the tip was removed from the fixture and checked on the tooling used for fabrication. The answer was the same; no permanent set.

Since wing tip No. 1 was not damaged in any way, a decision was made to subject it to the 200 cycle repeated load test.

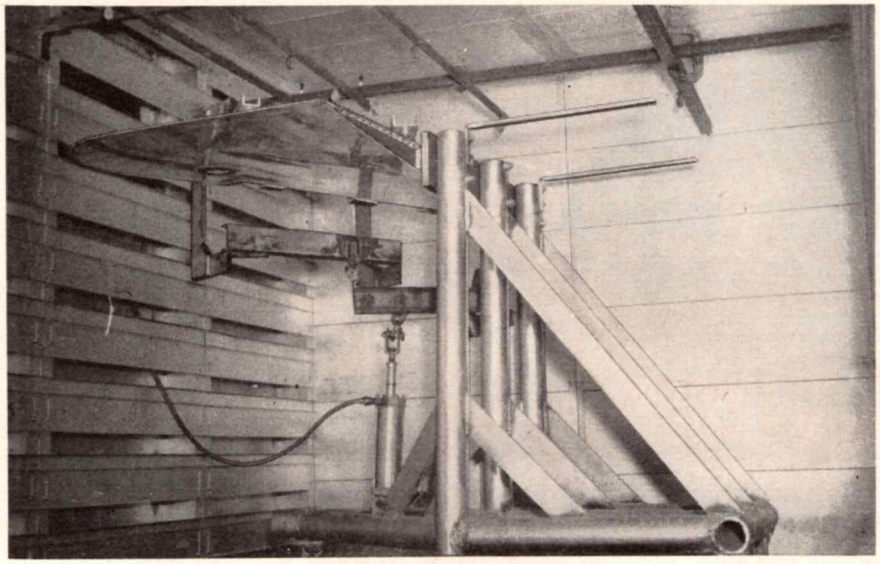
Tests began after the fixture was repaired and reinforced. The time required to complete the 200 cycles amounted to about five weeks, due to the time required to heat and cool the test tip. The test set-up was installed in a large oven with the deflection wires running through the oven walls to the recording instrumentation.

After 200 cycles of repeated load applications, no permanent set had occurred. Loads were then increased until failure occurred. Load at failure, while at 240 deg. F. was 176 percent of design ultimate. Localized failure of the leading edge attaching flanges was caused by the concentrated load applied at that point. This condition would not actually exist in the airplane. Again there was no failure of adhesive bonds or skins.

The results of these tests were gratifying and justified the designer's faith in metal sandwich components for primary structures.

The tests further proved that with proper design, careful selection of materials and strict adherence to processing controls, sandwich structures are far more efficient than the conventional. END

Delta wing tip in oven being given a complete fatigue load test at 240 deg. F.



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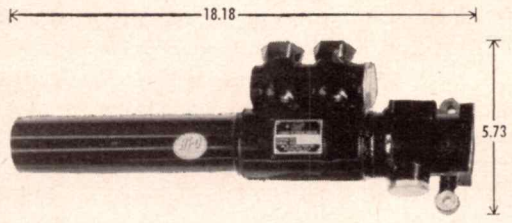

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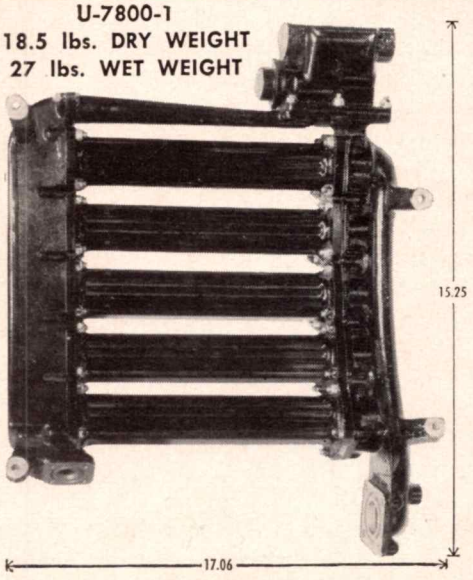

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Von Karman of the Jet Age

By T. F. WALKOWICZ

DR. Theodore von Karman, who came to this country some 25 years ago from Germany, is the oldest (75) member of a quartet of Hungarian scientists whose genius has had a profound impact on the military strength and security of the United States. The other three are E. P. Wigner, of Princeton, leading nuclear reactor designer; John von Neumann, of Princeton, outstanding mathematician and developer of ultra-high-speed electronic computers; and Edward Teller, father of the H-bomb.

Karman's first work in applied military aeronautics began with a meeting of a Committee on Air Corps Research of the National Academy of Science, in 1938. The meeting was called by General of the Air Force H. H. Arnold, who asked for the help of the scientists on two problems—de-icing of windshields and rocket-assisted takeoff for bombers. Dr. von Karman, it was agreed, should take on "the Buck Rogers stuff." He was then Director of the Guggenheim School of Aeronautics, California Institute of Technology.

About 1939, the Air Corps Materiel Division at Wright Field initiated the 20 ft. propulsion wind tunnel project, and with his colleague, Prof. John R. Markham of M.I.T., Karman became leading consulting engineer. This wind tunnel played a significant role in developing the B-36.

About the same time, the late "Eddie" Allen persuaded Boeing's management to build a modern wind tunnel, and to retain von Karman and Markham as consulting engineers. At a time when high Reynolds number wind tunnels were fashionable, Karman recognized the future importance of high Mach numbers. This basic thought guided the design of the Boeing tunnel, and has proved of great significance in the development of the B-47, B-52, and Boeing 707 jet tanker.

EDITOR'S NOTE: Dr. Theodore von Karman, who this month figures in the aeronautical headlines as one of the greatest scientists of the jet age, is also one of the most paradoxical and least-known. A pre-World-War-II refugee from Germany, he became a close friend of General of the Air Forces Henry H. (Hap) Arnold and was once mistaken for General George (Blood and Guts) Patton. But he could play to perfection the role of the absent-minded professor, and his life-long love has been teaching. Among the planes he has been influential in designing are the B-36, B-47, B-52 and the 707. His tablecloth figuring marked the inception of the Bell X-1, first plane to break the barrier of sound. T. F. Walkowicz, one of the scientist's associates gives an exclusive close-up profile of aviation's 1954 Man of the Year, chosen as this year's Wright Brothers Memorial Trophy winner.

At a Wright Field breakfast in early 1943 with Brig. Gen. Franklin O. Carroll, then Chief of the Engineering Division, in a typical "table cloth" design session, the soldier and the scientist laid out the design of the Bell X-1.

At Carroll's request, Karman also agreed to initiate jet propulsion courses at Caltech for Air Force officers. This gave him opportunity to return briefly again to teaching, the occupation which he loves most.

About mid-1944, General Arnold began to think in terms of World War III, and again turned to his old friend von Karman, who gathered around him a group of leading American scientists from the various fields having to do with airpower.

His procedure was unorthodox, and taxed the patience of some of Arnold's less imaginative military colleagues. Karman quickly "ran through" several tentative executive officers who couldn't accept the notion of "working for a civilian in the Chief's office." The matter was settled when Major General "Fritz" Glantzberg, an old M.I.T. graduate, arrived on the scene and quietly went to work. General Arnold placed bets on whether Glantzberg would get Karman to join the Air Force before Karman converted Glantzberg into a scientist. Karman won.

The work of Arnold's Scientific Advisory Group was sparked by von Karman's great knowledge and leadership, and seasoned by frequent debates between Karman and Arnold. The latter had a habit of reading 30-page progress reports the same day they were turned in, and returning with a demanding roar that the group think in terms of 1000-2000-mile-per-hour combat speeds, rather than "World War II slowpoke speeds" in the 600-mile-per-hour class.

With the fall of Germany imminent, Arnold dispatched Karman and a team of his scientists to Europe and thence to Japan. The team arrived in Paris just before

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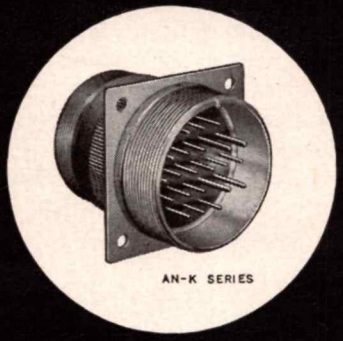

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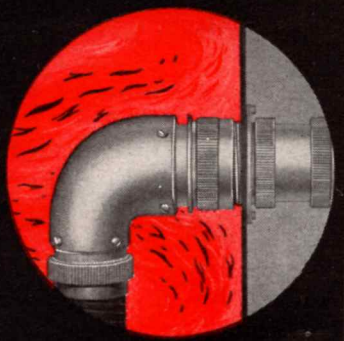

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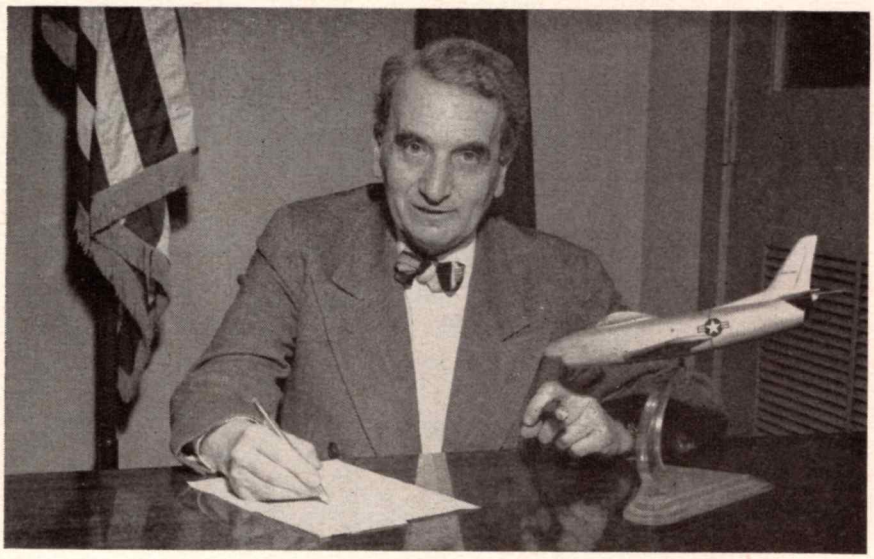
V-E Day, and proceeded quickly to Braunschweig, Goering's prize aeronautical research center. There they found the results of German research on sweepback and its drag-reducing effects for flight at high subsonic Mach numbers.

Through the alertness of George Schairer, staff aerodynamicist of Boeing and a member of the SAG, the straight-winged B-47 of that time was scrapped and the design of the successful swept-wing B-47 initiated. Members of another technical intelligence team flew the swept-back wings of the ME-262 to North American Aviation in California, where they were copied to become the wings of the F-86 Saberjet at about the same time.



Dr. Theodore von Karman has recently added to his long list of honors by being awarded the first Astronautics Award to be given by the American Rocket Society for his contributions to space flight

During this period, Karman was one of several scientists invited to Moscow for the celebration of the 230th anniversary of the Soviet Academy of Sciences. At a cocktail and dinner party in the Kremlin, with Molotov as toastmaster and Stalin being present, he first encountered Soviet post-war genius. A Soviet scientist asked Karman who he thought had contributed most "to the defeat of the Nazi hordes." Karman modestly replied that it was "perhaps fifty-fifty." Roaring laughter, his hosts advised him that the correct estimate was "at least 90 percent Soviet, perhaps 10 percent Allies."

Replied Karman:

"Seems to me the British and the Americans will have a lot of trouble dividing that 10 percent."

In Moscow, he made a series of requests for permission to visit an aeronautical research center and for a visa to visit Budapest, beloved city of his birth, en route back to Paris. Neither the permission nor the visa came through in time. Karman could understand being kept out of Soviet research centers. But the refusal to let him visit Budapest he considered bureaucratic stupidity.

Undaunted, he sauntered off across the Moscow airfield, dragging his B-4 bag behind him and asking for the destination of various aircraft parked on the line. Finding one headed for Budapest, he calmly boarded, instructing the pilot to depart. The story of his extrication and return to the Western Side, after landing at a Soviet-controlled airfield in Budapest, still remains to be told!

On another trip he boarded an ATC aircraft for a trip to Paris, and found himself sitting next to a captain deeply engrossed in a book entitled *Mathematical Methods in Engineering,* by Karman and Biot. The captain soon became impatient with the old man who nodded his head in the negative every time the captain tried to solve a mathematical equation. Finally, one of Karman's group advised him who the old man was, and the professor conducted a one-man class for the rest of the trip. Another time, Karman's C-54 arrived unannounced at the precise time set for the arrival of the late General George Patton. Before his identity was established, the old professor, with his hearing aid, slowly sauntered from his plane to the tune of "Ruffles, Flourishes, Spit and Polish" prepared for "Georgie" Patton.

In late October, 1945, as Karman's group readied for its trip to Japan, "Hap" Arnold suffered his first heart attack and, in a telecon conference, asked whether Karman could advance the completion date for his group's work. The old man became troubled, for he was still unprepared. The incident provided Karman's associates with an insight into the important role which Karman's devoted sister, the late Dr. Josephine de Karman, played in his professional life. At times when others thought that "the Boss" should be working, "Pipa" de Karman was all animation and conversation, leading her brother and his associates from one party to another. She knew instinctively when he was still not ready to sit down and work. When he was, Pipa became his isolation, and nothing was allowed to disturb her brother's concentration. Thus it was that in the quiet of the library at the Sorbonne, in November and December of 1945, there was written a volume entitled: *Science: the Key to Air Supremacy,* one of the major guides to the development of U.S. airpower during these critical post-World War II years.

Karman believed that the transition to supersonics would have to take place first in the minds of American engineers. His comprehensive presentation of the theory of supersonic aerodynamics in the 1946 Wright Brothers Lecture was a major contribution. Simultaneously, he worked with many rising young scientists on such basic problems as turbulence, boundary layer, and heat conduction. This, plus his work with the Aerojet Engineering Corporation, which he helped establish, kept him well occupied.

He remained as Chairman of the permanent Scientific Advisory Board, which Generals Arnold and Spatz had set up. Under his lead-

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ership, the Board finally rebelled against the steady deterioration in the qualitative strength of American airpower.

In early 1950, at the Board's recommendation, the late General Hoyt Vandenberg established the Air Research and Development Command and the Deputy Chief of Staff—Development in the Air Staff, to give USAF R&D activities the stature needed to fight for adequate R&D resources.

The reorganization provided the framework, and the Communist attack in Korea provided the impetus, which the fight for additional R&D resources required to be successful.

Karman turned toward Western Europe. There many of the world's leading scientific thinkers were attempting to work without the benefit of leadership, with deplorably inadequate resources, and with no opportunity to carry through new ideas to the point of practical application. Karman set about to do for West European aeronautical science what the Marshall Plan and Point 4 were doing for the West European economy and its industry. With the blessing of Secretaries of Defense and Air Lovett and Finletter, and the backing of General Vandenberg, he established successfully the NATO Advisory Group on Aeronautical Research and Development.

AGARD's results are now becoming apparent, with West European aeronautical science polarized under Western leadership, and beginning to make significant contributions to aeronautical progress.

During the initial days of creating AGARD, Karman's sister died. The old professor grieved, and none of his friends knew whether he would ever work again. But the old man slowly returned to AGARD with renewed vigor, and then turned to the field of combustion, whose elementary state of development was a sign more of its complexities and challenge, rather than of its great importance in the jet age. Simultaneously, he prepared a historical volume on aerodynamics, weaving a fascinating story with the names of those who gave aeronautical science its birth, life, and growth.

The volume is appropriately dedicated "To the memory of my sister, Josephene de Karman, whose devoted companionship secured for me the peace of mind necessary for scientific thinking".

The old man is now almost 75. He smokes no cigars, and his close friends drink most of the fine brandy that "Jackie" Cochrane still sends periodically.

His mind still functions with great clarity on the most complex scientific problems; and the old professor's explanation of the physical significance of higher order partial differential equations still amazes the layman.

In his apartment on the Left Bank in Paris, and during his travels all over Western Europe and to the United States, Dr. Theodore von Karman still finds his greatest pleasure in an opportunity to teach and work with those who are as young in mind as he. END

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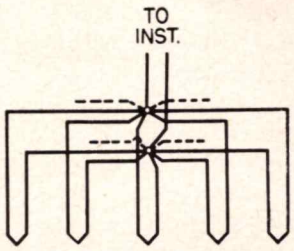


Fig. 1 Basic averaging method is that with all thermocouples of equal resistance brought to a common junction point

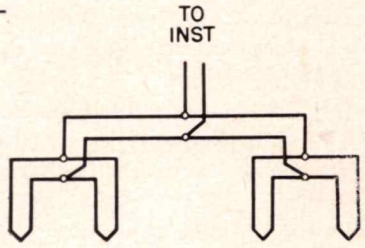


Fig. 2 Variation of common junction type paralleling system can be used to average four thermocouples

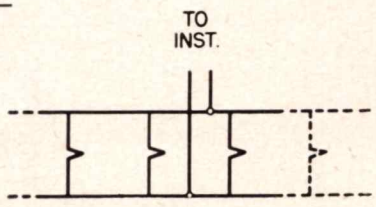


Fig. 3 Ladder-type averaging system uses any number of equal resistance thermocouples all meeting in heavy conductors

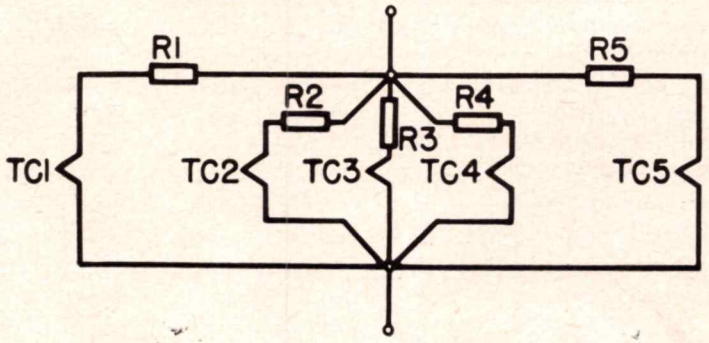
Jet Engine Thermocouple Averaging Systems

By H. H. CHAMBERLAIN
Meter and Instrument Division, General Electric Co.

Here is system giving average readings so long desired to defeat "hot spot" readings now prevalent

THE measurement of exhaust gas temperature in aircraft gas turbines is extremely important, since it gives an indication of both engine performance and engine life. At the present state of the art, thermocouples are used almost universally as primary detectors of exhaust gas temperature. Since thermocouples are sensitive to temperature only at one particular point, and since the exhaust gas temperature varies both radically and circumferentially inside the tail pipe or tail cone, it is usually desirable to use a number of thermocouples located at various points around the circumference of the tail pipe or tail cone. The average output of these thermocouples then provides a measure of the gas temperature.

Fig. 4 A dc network setup simplifies work of determining inherent errors in the three systems



TC1	1200F	R1	NORMAL
TC2	1140F	R2	5% HIGH
TC3	1260F	R3	5% LOW
TC4	1260F	R4	5% LOW
TC5	1140F	R5	5% HIGH

An average temperature reading is usually obtained by connecting the thermocouples in parallel. Although series connections could theoretically be used, in practice this is not done for two rather important reasons:

First of all, in the series arrangement, if one couple open-circuits all indication is lost. This, of course, does not happen in the parallel connections.

Secondly, since thermocouple output is proportional to the difference in temperature between hot junction and cold junction, in order to get a true indication with the series connection it would be necessary to bring all of the cold junctions back to the instrument to obtain a reference junction. This, of course, would make for a bulky installation in cases where more than two or three thermocouples were required.

With parallel connections, there are three methods of obtaining an average reading in general use today, all of which are electrically and thermo-electrically equivalent if designed properly.

Averaging Methods

The first method to be discussed and the one which might be referred to as the basic method, is that in which all thermocouples are of equal resistance and are brought to a common junction point as shown in Fig. 1.

A lead is then brought from this common junction to the instrument terminals. Although this system can be somewhat cumbersome mechanically, since the distance from the various thermocouples to the common junction may vary, in value.

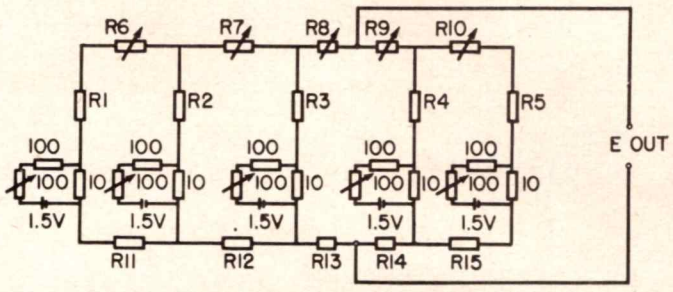
First, it is impossible to maintain exactly equal resistance in all of the thermocouples.

Secondly, as the thermocouples pass around the outside of the tail pipe to connect to the common junction, they pass through regions of varying temperatures. Since the combination of chromel and alumel wire has a temperature coefficient of approximately 0.1% per degree F, an additional resistance error is introduced which is proportional to the difference in the average temperatures seen by the total length of the various couples.

The second method, (Fig. 2), which is a special case of the basic common-junction type paralleling system, is frequently employed when the output of four thermocouples is to be averaged. This system uses two pairs of thermocouples, all thermocouples having equal resistance. The two pairs are joined together at a common junction by means of two leads, each of equal resistance. The two leads are generally referred to as the harness, while the four thermocouples and their associated leads are known as the couples. This system, of course, is based on the same theory as the basic common junction method in that, under ideal conditions, the resistance from each thermocouple junction back to the common junction is equal.

The third type of averaging scheme, sometimes known as the ladder-type, is shown in Fig. 3. This system uses any number of equal resistance thermocouples all brought into a pair of heavy conductors of thermocouple material, the lead usually being brought out near the middle of this buss. From Fig. 3 it is clear that if the buss bars are made sufficiently heavy, the resistance values in the busses will approach zero, and the scheme then reverts to the common junction or basic type of averaging. For this system to be successful therefore, the resistance of the busses must be low compared to the resistance of the thermocouples. In practice, if the individual thermocouple resistances are 2.5 times as large as the total resistance of the buss bars, errors will be reduced to a point well within the guaranteed accuracy of standard thermocouple wire. For a spread of 100 F individual thermocouple resistances need be only 0.6 times the total resistance of the buss bars.

Fig. 5 Typical error determination on basic common junction type thermocouple



DC ANALYZER SCHEMATIC
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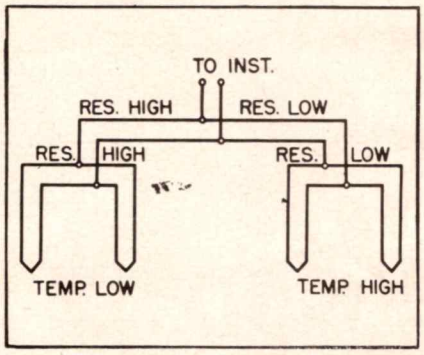
THERMOCOUPLE RESISTANCES		
R1,2,3,4,5	20,000Ω NOMINAL	
HARNESS RESISTANCES		
R6,7,10	4,460Ω NOMINAL	
R8,9	2,230Ω NOMINAL	
R11,12,15	1,860Ω NOMINAL	
R13,14	930Ω NOMINAL	

NOTE:
PARTS MAY BE REARRANGED TO SIMULATE OTHER AVERAGING METHODS. RESISTANCE VALUES SCALED UP BY 10^5

The third method, sometimes known as the ladder-type, is shown in Fig. 3. This system uses any number of equal resistance thermocouples all brought into a pair of heavy conductors of thermocouple material, the lead usually being brought out near the middle of this buss. From Fig. 3 it is clear that if the buss bars are made sufficiently heavy, the resistance values in the busses will approach zero, and the scheme then reverts to the common junction or basic type of averaging. For this system to be successful therefore, the resistance of the busses must be low compared to the resistance of the thermocouples. In practice, if the individual thermocouple resistances are 2.5 times as large as the total resistance of the buss bars, errors will be reduced to a point well within the guaranteed accuracy of standard thermocouple wire. For a spread of 100 F individual thermocouple resistances need be only 0.6 times the total resistance of the buss bars.

Fig. 6 Conditions present in highest error calculation



Comparison of Errors

A study of inherent errors in the three systems was made in order to be able to compare their performance. To simplify the work of determining these errors, a d-c network was set up to simulate the thermocouple circuit. This network

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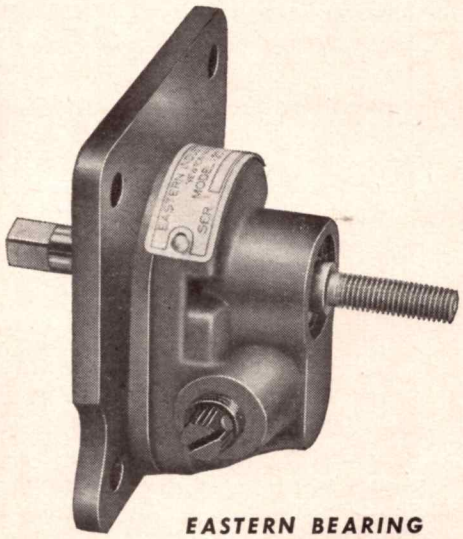

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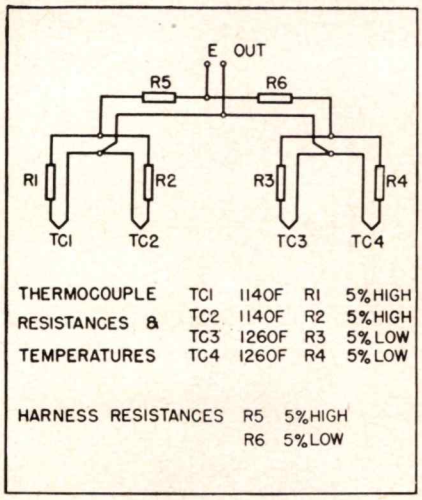


Fig. 7 Error in these conditions will be 0.25 percent

is shown schematically in Fig. 4.

In the study of inherent errors, every attempt was made to pick the most unfavorable conditions of temperature patterns and resistance errors possible, so that the results given in terms of percent error would be the maximum.

In all cases temperature variations were set at plus or minus five percent, or a spread between couples of 10 percent. On the basis of 1200 F. average temperature, this would be 120 F. Resistance variations were also assumed to be plus or minus five percent since it was felt that both of these tolerances were representative of the worst that might be expected in actual engine operation and in actual manufacture of thermocouples and components.

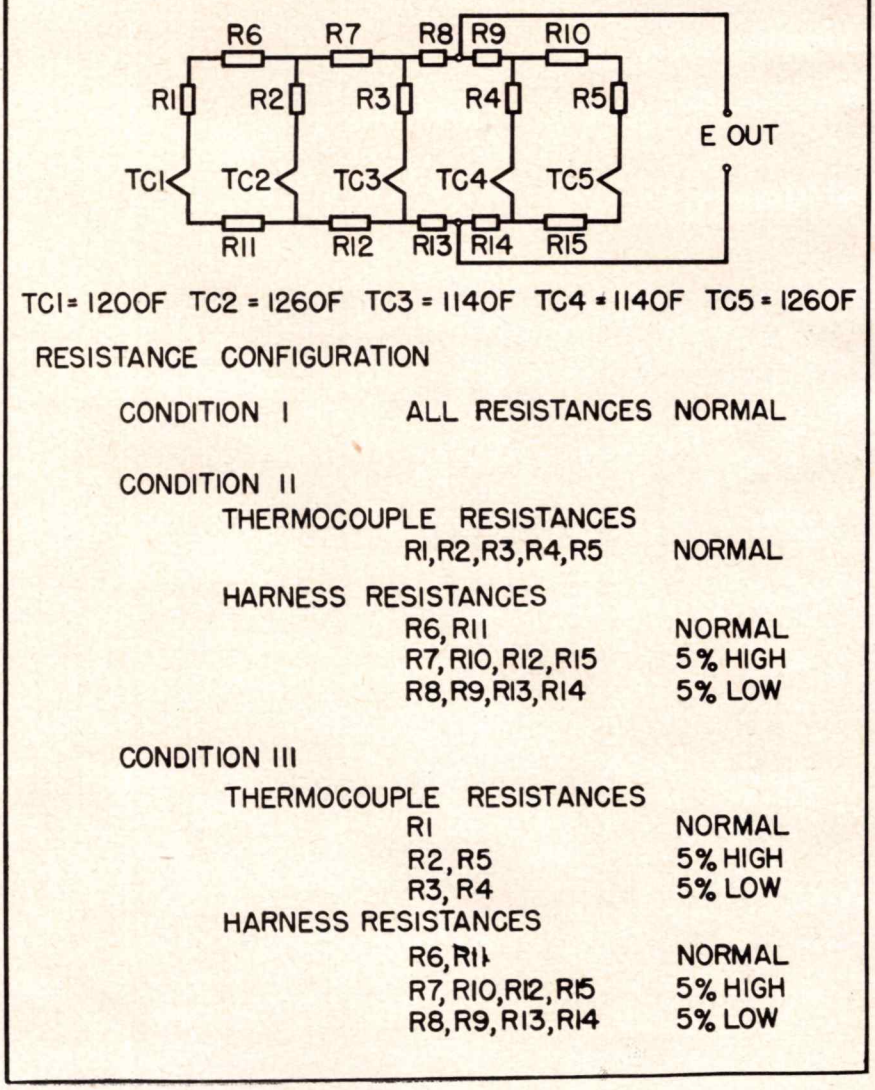
As an example of combining these variations to give the largest error possible, it will be noted that when a thermocouple output is assumed to be high, the resistance of that particular thermocouple is assumed low, thus emphasizing the error. This, of course, is not necessarily a normal condition but is done merely to assure that the resulting percent errors will be the maximum.

Error Determination

For a typical error determination on the basic common junction type thermocouple paralleling system, a set-up as given in Fig. 5 using five thermocouples will be assumed. The temperature and resistance values will be as shown. Under these conditions, the network analyzer output as read on the d-c potentiometer deviates from the arithmetic average of the five voltages by 0.3 percent or 2.4 F at 1200 F. Since the error is proportional to a constant times the percent resistance error, if the couples had been selected in such a way that their resistance variation was only plus or minus one percent, the error would have been 0.04 percent or 0.5 F at 1200 F. If the couples had been selected to have exactly equal resistance at room temperature, the error, again at room temperature would have been zero percent. Let us assume for the moment however that the conditions first described exist, and that one of these thermocouples in the actual installation, sees an average temperature from its hot junction to the common junction which is 50 F different from that seen by the other couples. In that case its resistance will differ from that of the other couples by 50 times the temperature coefficient of resistance (50 x 0.1) or five percent. It is in this type of error that the theoretical perfection of this basic averaging scheme falls down badly, since a 50 degree difference in average temperature for each one of the thermocouples over its entire length is not at all unlikely, but rather is quite probable.

For the equal resistance system, inspection and calculation show that the largest error occurs under the conditions shown in Fig. 6.

Fig. 8 Temperature pattern for ladder type system calculations with five thermocouple arrangement



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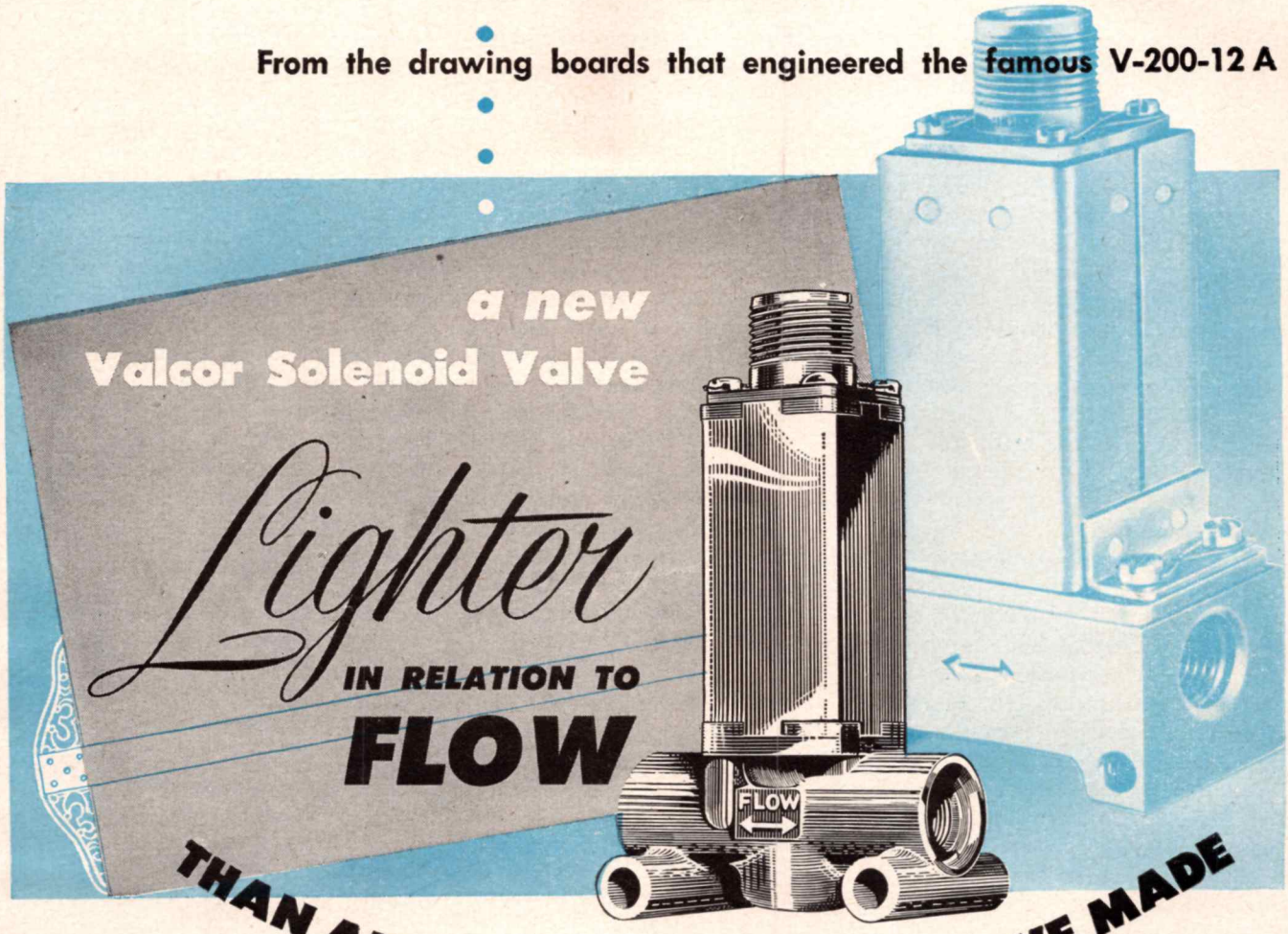

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The sign of the error will reverse when the temperature pattern reverses.

Under the condition of five percent high and low in resistance and temperature, as shown in Fig. 7, the error will be 0.25 percent or 4 F at 1200 F. With the same temperature and resistance configuration but with resistance errors of plus or minus one percent, the resulting error in average temperature would be 0.06 percent or 0.72 F. at 1200 F. In theory the couple resistances may all be made exactly equal and the two harness halves may be made exactly equal. In practice however, even if this is done, the same restrictions apply to this type of harness as apply to the basic common junction type: If the two harness halves, for example, pass through regions where the average temperatures are 50 degrees different from one another, then the resistance of the two harness halves will become unequal by five percent. Thus, it can be seen that in this type of averaging scheme as well as in the basic common junction type, it is somewhat fallacious to refer to them as equal resistance systems, except under ideal conditions.

For the ladder-type system, calculations will be made on a five thermocouple arrangement with the temperature pattern shown in Fig. 8. Hereafter, the parallel buss bars will be referred to as the harness. When all resistances are normal, condition I, the error is 0.79 percent or 9.5 f. at 1200 F. This temperature pattern was chosen to give the maximum possible error and although this error is somewhat larger than either the basic common junction type or equal resistance type, it is not large enough to be significant.

Under resistance configuration condition 11, which shows a plus and minus five percent change in certain harness section resistances, the averaging error is 0.8 percent or 10.2 F. at 1200 F. This relatively small increase in percent error as resistance errors are introduced is, of course, due to the fact that the harness resistance is kept low. From this it follows that if the harness is made heavy enough to reduce its resistance to practically zero compared to the thermocouples, then any change in ambient temperature through which it passes has negligible effect on the accuracy of the average. This is natural, since the system has then been reduced to the basic common junction type, the busses now representing the terminals of the common junction system.

There still exists, of course, the same possibility of error due to varying couple resistance as existed with the common junction scheme. Resistance configuration III under Fig. 8 shows a temperature and resistance pattern similar to condition II except that now the couples have been allowed to vary plus or minus five percent while maintaining the harness sections at a more reasonable value of plus or minus one percent. Under these conditions the averaging error is 0.92 percent or 11 F. at 1200 F.

Even these small errors may be further reduced in three ways.

First, the harness wire diameter may be increased. Since the harness resistance varies inversely as the square of the wire diameter, a very modest increase in diameter will result in a sizeable improvement in the couple - to - harness resistance ratio and thus in the averaging accuracy.

Second, the thermocouple resistance may be increased either by using finer wire or by building in a resistance winding.

Third, although perhaps this may not be quite as convenient mechanically because of engine configuration and possible interferences, the ladder may be closed as shown in Fig. 9.

In addition, errors present in the measurement system as a whole will tend to reduce the significance of the ladder type harness error. These errors which include thermocouple wire calibration tolerance, lead resistance changes due to ambient temperature change and cockpit indicator tolerances may total as high as five percent, or 60 F. at 1200 F.

Conclusions

Two general conclusions may be drawn on the basis of the foregoing discussion:

First, that there is little choice electrically or thermo-electrically between the various type of paralleling schemes for averaging the output of thermocouples in exhaust gas temperature measurement systems and

Second, that a number of advantages including lighter weight, greater design flexibility, and a cleaner mechanical installation may be obtained by the use of a properly designed ladder-type system without introducing significant averaging errors. END

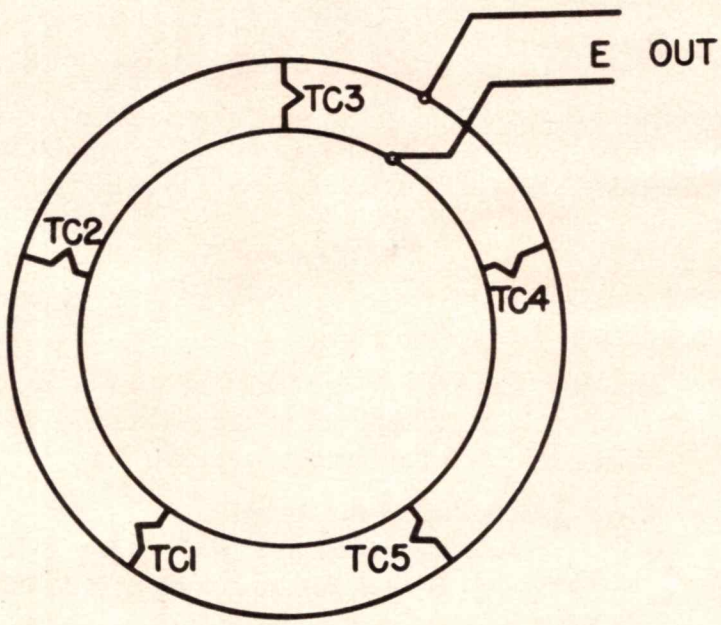

Fig. 9 Schematic showing ladder closed

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SAMUEL S. OLEESKY
Plastics Editor
AERO DIGEST

AERO DIGEST'S Plastics Editor says, in this, his first contribution to the magazine, that plastics are in aviation to stay. No longer ersatz, they are filling standard needs. But he adds a warning—don't think you can do a slapstick job of applying plastics and stay out of trouble. And we add a helpful note—Mr. Oleesky is available to AERO readers facing a special plastics problem and desiring expert advice.

How expert his advice can be is summed up by his career. A graduate electrical engineer, he encountered—and licked—scores of plastics problems during the war for the U. S. Navy, where in various capacities he was in charge of designing and installing radar, sonar, communications, fire-control and counter-measure electronic equipment on all classes of vessels.

A post-war plastics specialist in design consulting, today he is Chief Scientist of Reinforced Plastic Consultants and Engineers, and Vice-President and Chief Scientist of Micronics, Inc. He is also a member of the Board of Directors of the Society of the Plastics Industry.

If you have a plastics problem you would like to take up with him through AERO DIGEST, write:

Samuel S. Oleesky
Plastics Editor
AERO DIGEST
511 11th Street NW
Washington 4, D. C.

THE EDITORS

Aircraft Plastics

By SAMUEL S. OLEESKY

Plastics, no longer a substitute material, has solved most of its early obstacles and faces expanding applications

LACK of standarization of reinforced plastics today handicaps the plastics-in-aviation program, but the plastic industry is rapidly moving toward solving this problem.

The aircraft industry has, of course, accepted the synthetics for ever-widening application. They have found a new material that can solve many design problems, provided the material is used with a knowledge of its strengths and weaknesses. They are accustomed to turning to a table of allowable stresses for aluminum or steel and finding values that are predictable and effectively invariant.

Nothing of that nature is yet available in reinforced plastics. Until such a time as standardization comes about, designers will be understandably reluctant to select these materials.

Is anything being done to overcome this obstacle? The answer is in the affirmative.

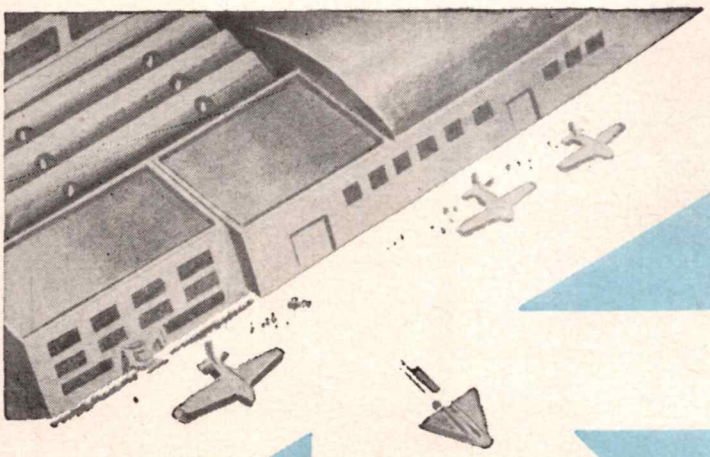
For there are deficiencies, and they are not minor. We are dealing with a material that is not homogeneous. With reinforced plastics we have, basically, a synthetic resin reinforced with a filler, much as cement, sand, and rock may be reinforced with steel bars to produce reinforced concrete. The filler, in most aircraft construction, is composed of fine fibers of glass, either in woven form as cloth, or in random distribution, as in mats or "preforms."

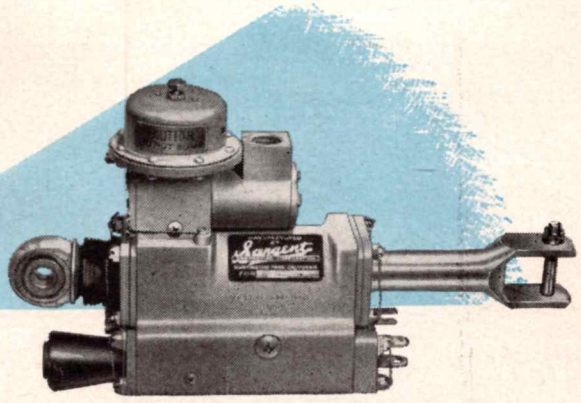
This heterogeneity of composition lends itself to variations in mixture. Different combinations of components result in different properties. Variations in molding techniques, cure cycles, and so forth, can result in wide variations of physical strength. Choice of resins, too, may cause fluctuation in results. Thus, a table of physical properties for reinforced plastics published by one fabricator may have absolutely no similarity to one set drawn by another. There are, for instance, dozens of weaves of glass cloth, varying in thickness from 2 mils to about 40 mils. There are several glass surface treatments, each designed to be compatible with particular types of resins. Molding pressures may vary from zero for contact molding to several thousand psi for matched metal tooling.

It is this apparent inconsistency that worries the mechanical engineer, the structural designer, and the aerodynamicist.

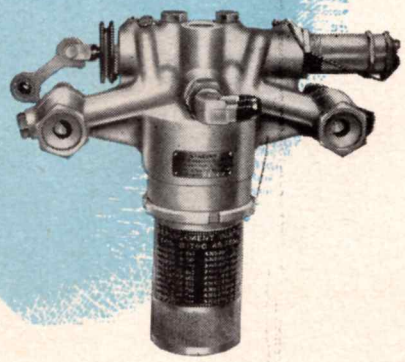
Under the guidance of the Reinforced Plastics Division, Society of the Plastics Industry, a Standards and Technical Committee has been established to provide the necessary information with the least amount of delay. Too, ASTM, SPE, and other interested organizations are moving rapidly on the problem and it should not be too long before this major obstacle is licked.

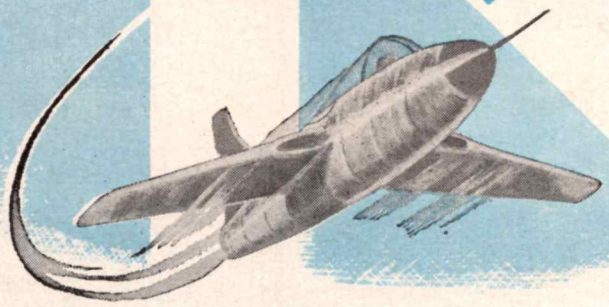
In the meantime, as emphasized elsewhere on this page, questions from AERO DIGEST readers are encouraged. If you have any proposed designs in which plastics seem to fit, we will be glad to comment on their feasibility and to suggest possible materials and/or design criteria. There is no charge for these opinions. END





Aircraft hydraulic and mechanical controls by Sargent





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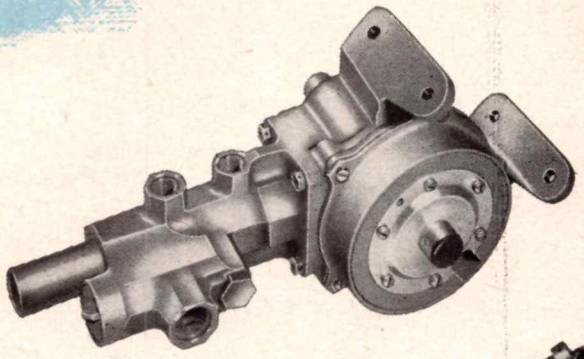

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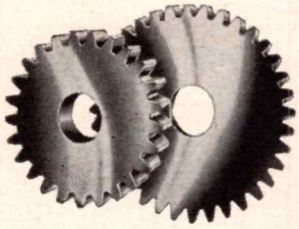

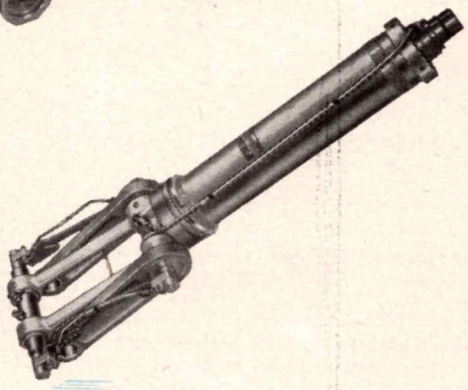

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"Good will" is the disposition of the pleased customer to return to the place where he has been well treated.
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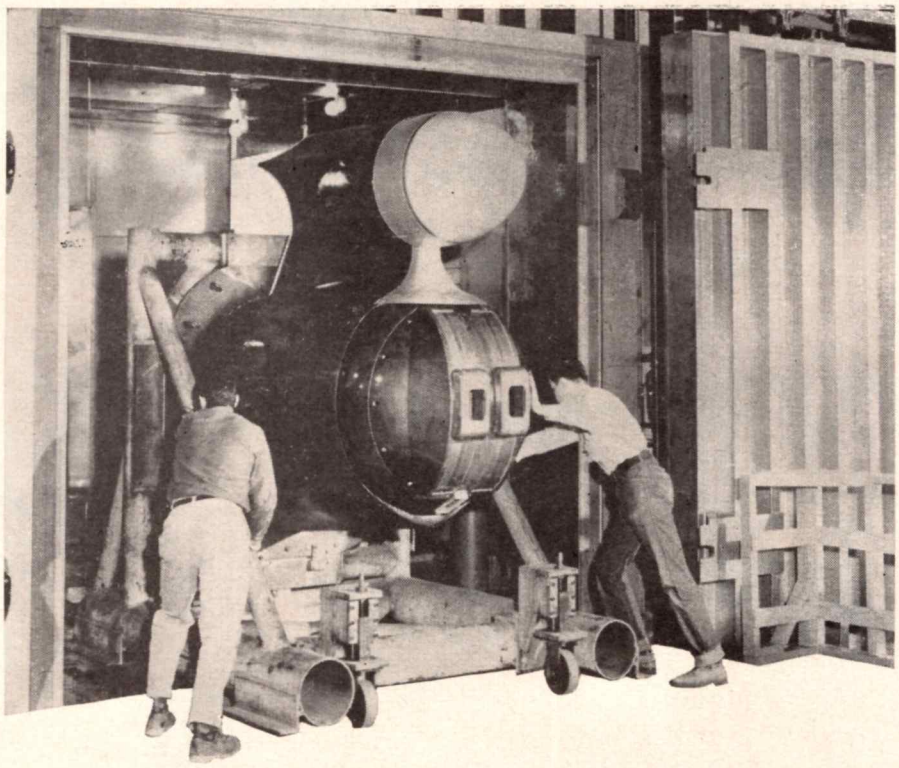
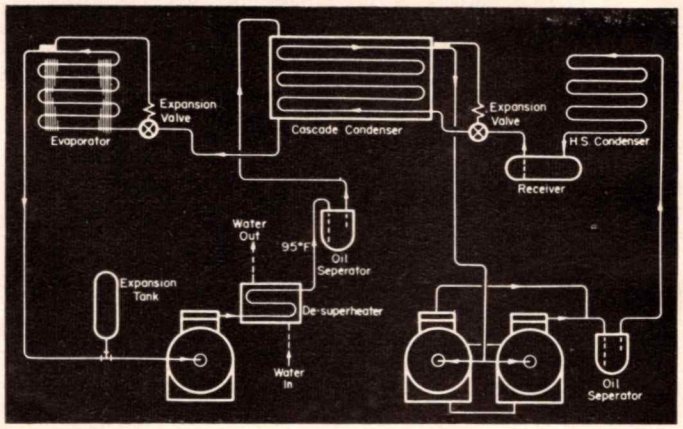


Radar controlled gun turret being wheeled into low temperature test chamber

Schematic diagram of cascade refrigeration system which produces test temperatures as low as —100 deg. F.



Giant Stratosphere Chamber

First such unit to be cooled by cascade refrigeration system, built by Tenney Engineering, Inc.

THE Crosley Division of Avco Manufacturing Corporation recently installed one of the largest low temperature stratosphere chambers ever built. Outside dimensions measure 19 ft. 6 in. wide x 15 ft. high x 22 in. long. Inside work-space dimensions are 11 ft. high x 11 ft. wide x 17 ft. long—large enough to house the radar controlled gun turret shown being wheeled into the chamber in Fig. 1.

The chamber, manufactured by Tenney Engineering, Inc., simulates altitudes to 80,000 ft. along with corresponding temperatures. The chamber can be used for extreme low-temperature testing and for environmental high temperature testing, the actual temperature range of the chamber being from —100 to 200 deg. F. Equipment on test can give off more than 51,000 btu/hr. yet the chamber will be maintained at constant temperatures as low as —85 deg. F.

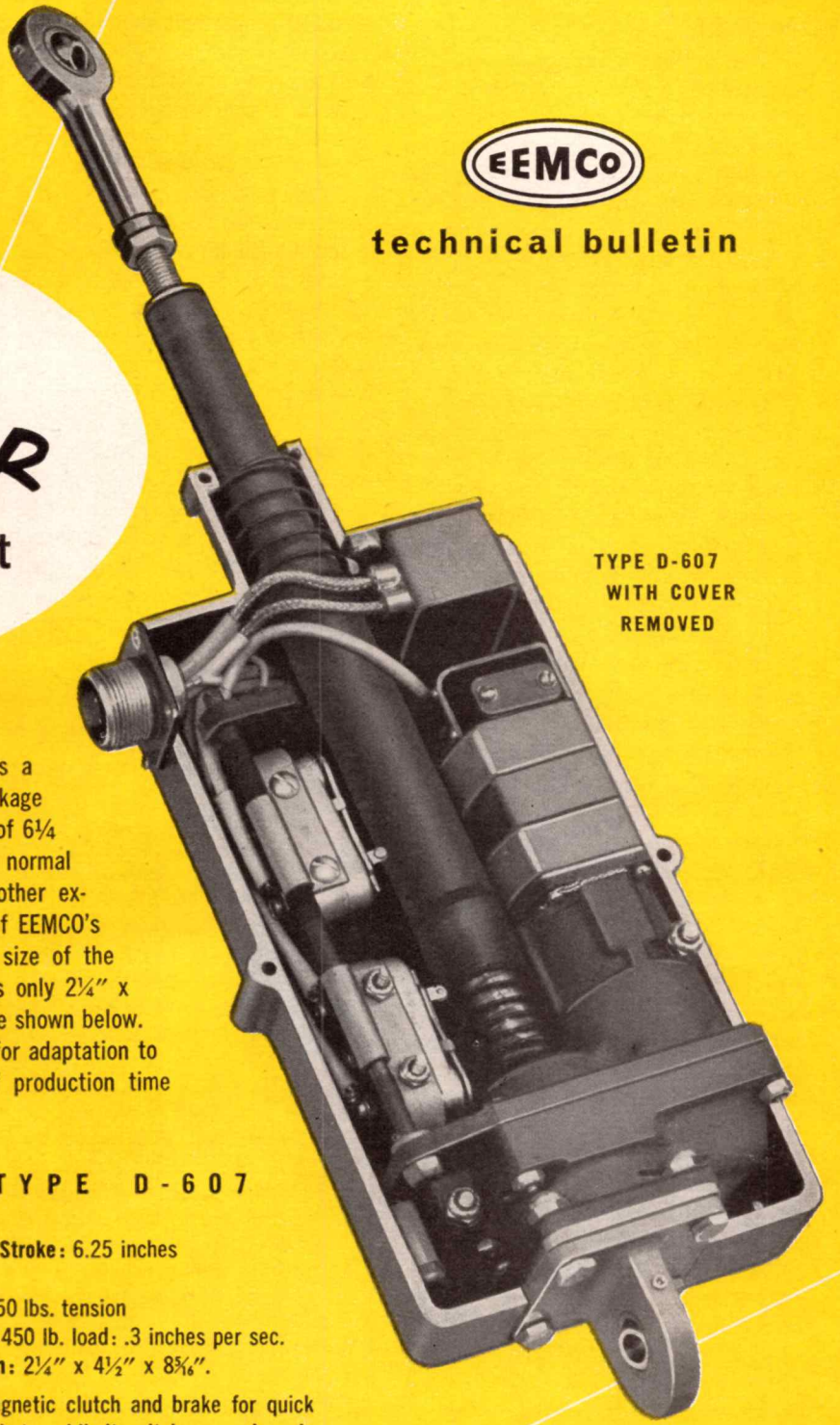
It is the first "walk-in" stratosphere chamber to be cooled by the cascade system of refrigeration. Using two refrigerants—the comparatively recent Freon 13 and Freon 12—this system reduces chamber first cost, results in lower operating costs, enables installation in a smaller area and provides a simpler refrigeration system.

Contributing to these advantages are the facts that: (1) The cascade system requires but ⅓ the compressor displacement capacity as the compound system formerly used, (2) there is no interstage cooling problem, (3) the system efficiency is about ⅓ greater, (4) there are no interconnected compressor crankcases for oil return, (5) less horsepower is required, and (6) the system operates at positive

EEMCO

technical bulletin

a New DOOR ACTUATOR for Transport Aircraft



TYPE D-607 WITH COVER REMOVED

EEMCO's new linear actuator, Model D-607 is a compact combination actuator and power package weighing only 4½ pounds. Having a stroke of 6¼ inches at .3 inches per second under a normal operating load of 450 pounds, it is another example of the ingenuity and precision of EEMCO's design and production team. Overall size of the activating section of Model D-607 is only 2¼" x 4½" x 8⅝". Other specifications are shown below. This same design can be altered for adaptation to other uses with a minimum of production time thus assuring early delivery.

SPECIFICATIONS ★ TYPE D-607

Weight: 4.5 pounds **Stroke:** 6.25 inches
Operating load: 450 lbs.
Ultimate static load: 7150 lbs. tension
Speed of stroke under 450 lb. load: .3 inches per sec.
Size of power section: 2¼" x 4½" x 8⅝".

Other features: Magnetic clutch and brake for quick stopping; adjustable travel limit switches; non-jamming end stops; radio noise filter; explosion proof.

NOTE COMPACTNESS OF COMPLETE UNIT

Electrical Engineering and Manufacturing Corp.

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Designers and producers of motors, linear and rotary actuators

rather than high-vacuum suction pressures.

The refrigeration system is diagrammed in Fig. 2. As shown, it has two interconnected refrigeration circuits. The evaporator of the first is actually the cooling element of the condenser of the second. Two 65 hp compressors in parallel, compress the F12 in the high stage. From here it passes through an oil separator to a Tenney 40 ton evaporative condenser where it is condensed to liquid. It next flows through a receiver to the expansion valve of the evaporator (which is the cooling element of the condenser of the F13 system). Here the refrigerant expands to a gas, absorbs heat, and returns to the compressors to repeat the cycle.

In the F13 system, a 100 hp semihermetically sealed compressor is used. The seal prevents possible loss of refrigerant. The charge in this case is approximately 260 lb.

From the compressor the refrigerant gas flows through a de-superheater which cools it to aid oil separation, the miscibility product being lower at the lower temperature. The de-superheater also reduces the amount of heat to be removed by the condenser. Next, an oil separator separates the oil droplets and returns them to the condenser. The refrigerant passes on to the cascade condenser (the cooling element is the evaporator of the F12 system) where it is condensed to liquid. The condenser is a shell-and-tube type, U-tubes being used rather than tubes fixed at both ends because the difference in room temperature and operating temperature is so great that expansion and contraction occurring when starting up and shutting down might dislodge the tubes.

From the condenser the F13 flows to the evaporator which cools the chamber. Instead of the usual single expansion valve, there are 28 individual Tenney valves, each feeding one of 28 separate evaporator circuits, no one valve being obtainable for F13 which would be suitable under these operating conditions.

The evaporator circuits discharge to two headers, each accommodating 14 coils. From the headers two suction lines convey the gas back to the compressor. An expansion tank is inserted on the line between the evaporator and the compressor to contain refrigerant when the system is not in operation, all the refrigerant being in the gaseous state under this condition.

A control panel containing pressure switches, gages, and 3-way solenoid valves is provided for the automatic operation of refrigeration system. The pressure switches include oil pressure protection devices, high pressure safety cutouts, and switches which in conjunction with 3-way solenoid valves produce automatic cylinder loading and unloading of the F13 compressor.

The chamber is heated by 36 kw heaters. Two blowers, driven by a 10 hp variable speed drive circulate air within the chamber. Because the air density decreases as the high altitudes are simulated, more blower capacity is required for high altitude testing than for testing at lower altitudes; therefore, the variable speed drive.

Two vacuum pumps are used to evacuate the chamber, one a 40 hp, 845 cfm unit, the other a 20 hp, 460 cfm unit. Once the chamber has been evacuated, vacuum is maintained by the smaller pump.

An unusual feature of the chamber is that it has a back door which opens to face out onto a firing range when the plant door is open. This makes it possible to fire guns from the chamber to test their performance at low or high temperatures. END

AERO DIGEST
I Remember . . . .

I MISSED THE BOAT

By FLOYD E. BARLOW

Learned to fly with Curtiss Exhibition Co., was test pilot for Marlin-Rockwell Aircraft, tested aircraft guns and bombs designed by a brother. Member, Early Birds.

Many thousands of hours in the air and many close calls have passed, but after forty years one episode still is as vivid as though it happened yesterday.

During 1912 I was a member of the famous Curtiss Exhibition Team of Aviators. Prior to that time I was employed, after graduating from the Curtiss School, as an instructor for that school at North Island, California. I guess that makes me one of the world's earliest flight instructors.

One day I was asked to flight test one of the school machines. The motor was tight because of new rings and pistons and became quite hot after a very short flight—in fact this plane, which was used in the second step of instruction was incapable of little more than straight flight. After flying about a mile, I landed, turned the plane around and then, for some reason, the engine stopped. I crawled under the tail outriggers and spun the prop but that didn't work so I decided the engine wasn't getting enough gas. The Curtiss used only a foot throttle so I had no way of opening the throttle only a little.

Then I had a brilliant idea. I wedged a small piece of wood behind the throttle to hold it open and whirled the prop again.

The motor started slowly on two of the four cylinders and the pusher started to creep forward. As I bent over to get outside the outriggers, the other two cylinders opened up—and away she went. I was a pretty good sprinter then but was able to get only within about six inches of the wing strut as the plane pulled away. I then dived desperately at the tail—and fell headlong into the dust.

The plane continued straight ahead and as the wheel dropped back, the world's first pilotless airplane took off in the morning light. It climbed steadily to about 200 feet, then started a nice left hand turn. As I watched, fascinated and helpless, the turn became sharper and a grand slide began. There was a terrific crash and a giant cloud of dust. All that remained was one end wing section and a couple of engine parts. Altogether the plane had flown about three quarters of a mile and had almost returned to its starting point.

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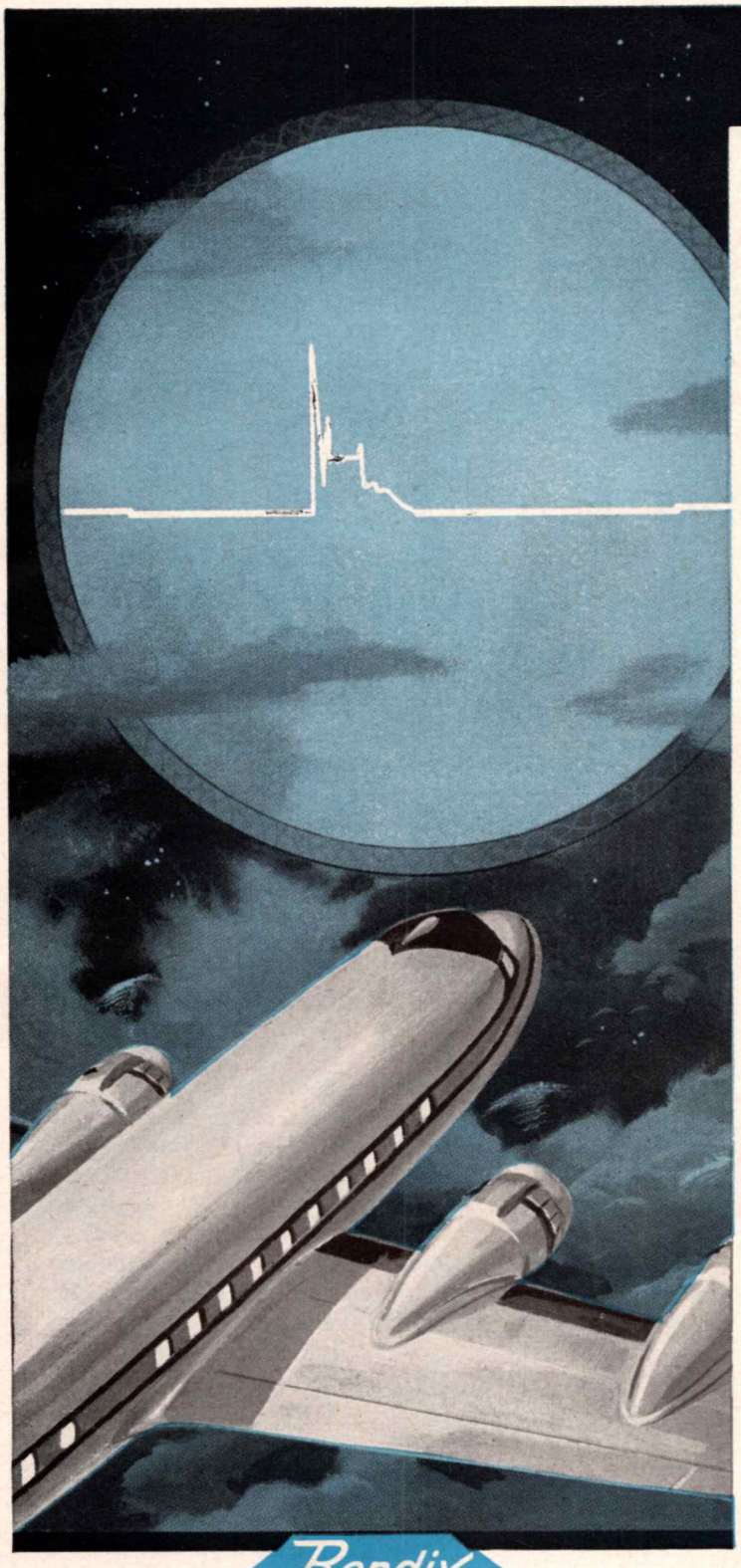

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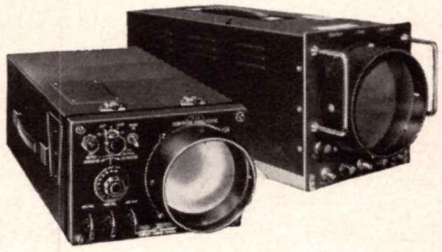

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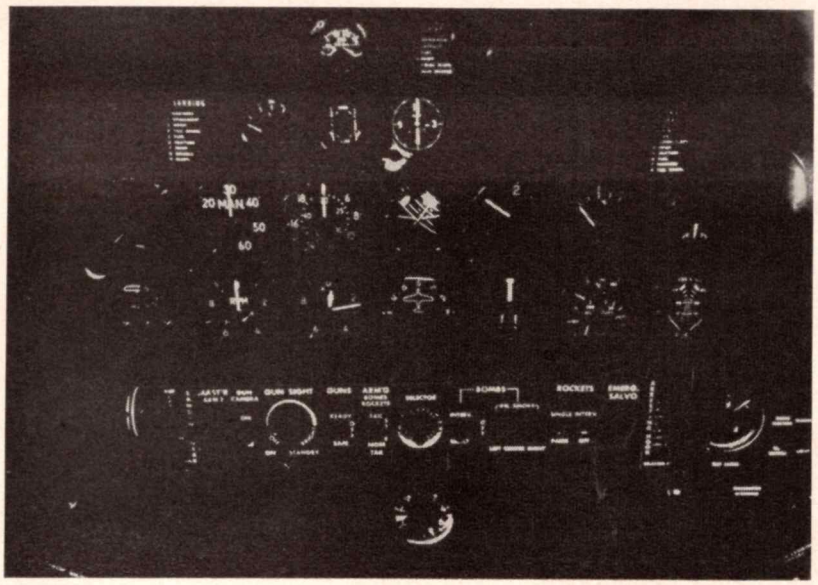


Some new ideas on the old bugaboo — cockpit lighting — and what can be done about it

By R. W. McKIRDY
V. P. Universal Equipment Company

Illuminated Controls for Aircraft Cockpits

ALL aircraft design stands or falls finally on what goes into the cockpit—the brain of the ship. The efficiency, the accuracy or the usefulness of all components is only as good as the controls, whether they be mechanical or human.

Until 1943, the limitations of an aircraft were not always recognized as reflecting the limitations of the pilot, the navigator or the engineer. But such a bare fact emerged from the investigation of many accidents, and 'human engineering,' largely psychological in character, moved in to work on the problem.

Human engineers measured and classified impulses and responses during World War II to discover impediments which delay and confuse the judgment.

They found that the operational characteristics of the military plane had increased so much and so often that the pilot was surrounded by a mass of new controls. His plane was a hospital ship or it was a photographic laboratory or it bristled with guns, or it was a refuelling unit. But whatever its new job, new controls or new instruments were added to the cockpit array.

Lighting effect inside an airborne fighting ship operating at night was more like a Christmas tree than $1-million in defense equipment. Blue lights, green lights, ultra violet, orange, white floods and winking signal lights of all kinds made for confusion and error. Every new piece of airborne equipment claimed its own peculiar lighting system, a distinction which the results rarely justified.

Out of this confusion of color, the human engineer emerged with some very definite findings. He recommended red lighting lying within the narrow limits of 6100 to 6800 Angstroms. This type of light excites only part of the eye retina, thereby reducing fatigue and eliminating after-image. He also recommended no more direct lighting from sources visible to the operator. Existing metal panels should be replaced by plastic lighting plates within which the red-filtered lamps were inserted.

Five years of work between Dayton and Washington resulted in a specification called AN-P-89. This has a performance end-point but somewhat sketchy specifications for the manufacturer. Materials of the required characteristics were finally laminated into a lighting plate which now takes the place of the old-fashioned aluminum 'nameplate.' Materials such as vinyl film and cast methyl methacrylate capable of withstanding heat, cold, salt-spray, humidity and abrasion are now formed into one five-layer sandwich with small red lights mounted in the plexiglas core.

In a cockpit, about one half of the console is occupied by control-panels, and the rest is filled with instruments. Of course, the visibility of his instruments is as important to the flyer as the legibility of his control-positions, but the application of indirect lighting to dials, pointers and counters has posed a somewhat broader problem. In size and shape instruments differ widely from one another. The method of their mounting and the fact that a large percentage are sealed, intensifies the problem of applying light from some common source such as a lighted panel.

Lighting integral with the instrument is desirable and some measure of success has been reached with a few selected types. But the majority of the problem still awaits a solution in the form of a lighting system easily and quickly applicable to the 50 or more types of aircraft instrument in general use.

Some 40 different instruments can now be lighted by an eyebrow

type of assembly. This lighting is carried inside a small metal guard which is mounted over the dial and follows the shape of the instrument bezel for the upper third of its circumference.

It is conceivable that instrumentation may be revolutionized completely as the result of current research or invention which aims to dispense with dials and pointers. In that event we may find ourselves with watches that give linear instead of circular indication, fuel gauges that are electronic, or altimeters that register by color or frequency progressions.

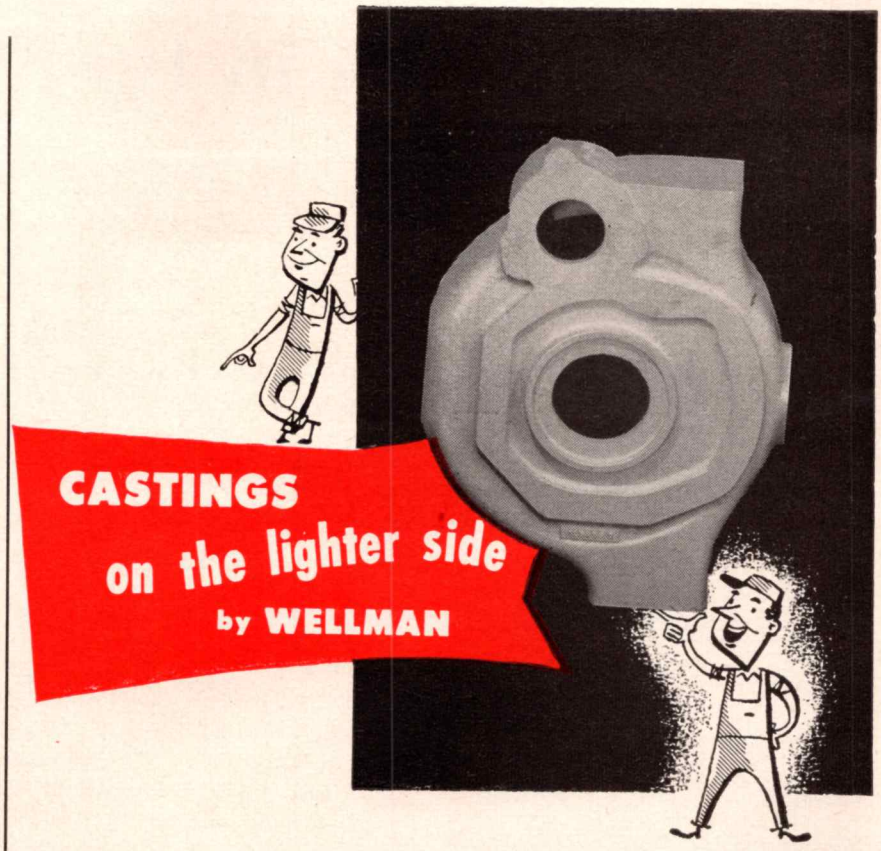
Regardless of how the problem of today's complicated instrumentation will be solved, it cannot be denied that simplification is long overdue, together with the reduction or removal of indicia which are either unnecessary or used only intermittently.

Much has been accomplished out of the new system of cockpit lighting, much has been saved in life and aluminum, much has been learned of our hitherto unmeasured capacity to think and to act unerringly, but much remains to be simplified as our thirst for speed grows daily. At speeds of over 760 mph. the pilot has no time to read some of his dials and interpret what he reads into action.

Two fairly recent developments in instrumentation are significant of this increase in flying speed and the progressive decrease in reaction time available to the flyer.

First, integration of controls permits five or six operations to be carried out by one movement of the controller, reduces reaction time, fatigue, and the complexity of mental and physical co-ordination and sequence pattern. Such integrated systems are already installed for controlling jet engine performance.

Second, where practicable, automatic systems are taking over the flyer's responsibility and operating at speeds incomparable to that of human reaction time. The human senses are being superseded by electronic and electric circuits. And this taking-over of control is surely imperative when two planes a mile apart approaching one another at speeds of 1000 mph. each have less than two seconds in which to avoid a collision. END



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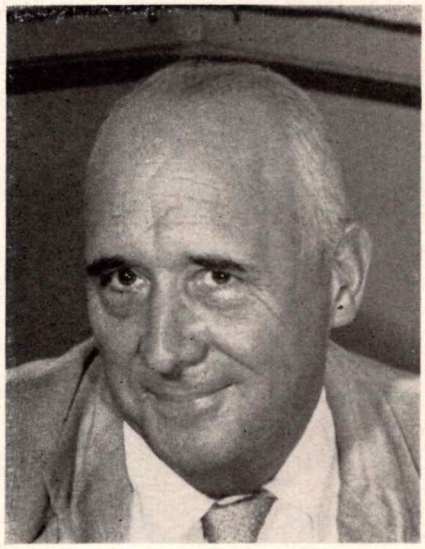
Names in the News

J. H. (Dutch) Kindelberger, Chairman of the Board and Chief Executive Officer of North American Aviation, Inc., and **E. H. Heinemann,** Chief Engineer of the El Segundo Division, Douglas Aircraft Corporation, are the co-winners of the 1955 Collier's Trophy, which will be awarded at the Wright Dinner, Dec. 17, in Washington. Kindelberger's work on the F-100 and Heinemann's on the F4D, led to the awards.



Earl Guisinger

Author **Earl Guisinger** of the song, "Whither Thou Goest", a former Army Ordnance Colonel is now in the Quality Control Division at Northrop, working on the F-89. His tune is a runaway best-seller.

President Eisenhower awarded this year's Harmon Trophies to **Major Charles E. Yeager** and **Jacqueline Cochran** at a White House ceremony in mid-November. Both awards were for the winners' achievements during the year in flying jets. They were guests of honor at a luncheon afterwards at which speakers included Secretary of the Air Force **Harold E. Talbott,** President of Bell Aircraft Corporation **Lawrence D. Bell,** and Bell General Manager **Leston P. Faneuf.**

Chaney Award, which is presented annually by the Air Force Chief of Staff for outstanding aeronautical achievements, goes this year to **Captain Edward G. Sperry,** Air Research and Development Command, for his work in testing the new downward ejection seat for the Boeing B-47 *Stratojet* bomber. The award carries with it a certificate, a plaque and a check for $500.

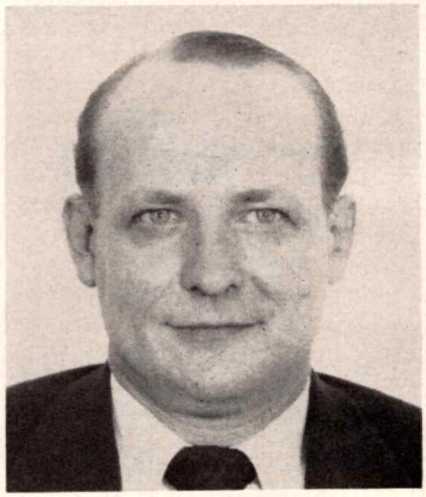
A. P. Fontaine is the new Director of Engineering and **Dr. A. C. Hall** General Manager of the Research Laboratories of the Bendix Aviation Corporation. Their appointment was announced by **Malcolm P. Ferguson,** President of the corporation.

Chief Engineer **E. F. Burton** of Douglas' Santa Monica Division received his 30-year pin the other day from President **Donald W. Douglas** and **A. E. Raymond,** Vice President-Engineering. A diamond award, for 40 years of outstanding service, goes to **Preston R. Bassett,** President of Sperry Gyroscope Company. The award was made recently by **Charles M. Green,** Sperry Executive Vice President.

Edward J. Scott is Operational Manager of the newly formed Greer Hydraulics of Canada, wholly-owned subsidiary of the New York International Airport company of the same name.

C. B. Wright has been appointed Chief Engineer of Aircraft Engineering and **J. R. May** Chief Engineer of Commercial and Administrative Engineering of Aeroproducts Operations, Allison Division of General Motors Corporation, Dayton. Appointments were announced by **R. E. Lynch,** Aeroproducts manager.

A. P. Fontaine



Edward J. Scott

Major General Gordon A. Blake, U. S. Air Force Director of Communications, has been appointed Air Force representative on the

J. R. May

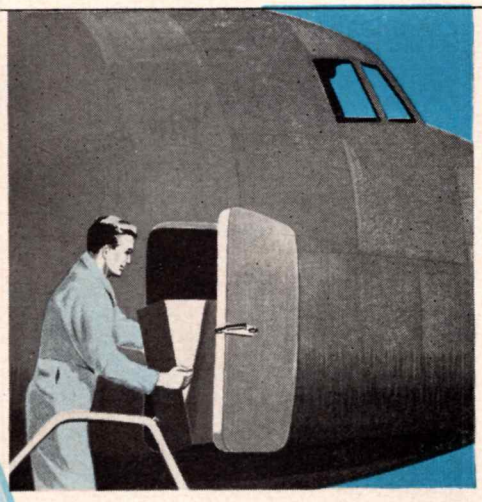
Executive Committee of the Radio Technical Commission for Aeronautics.

Kermit F. Wasmuth is new Director of Quality Control at Republic Aviation Corporation.

Randall H. Carpenter has been appointed Manager, Air Transport Division, Flight Safety Foundation, by Foundation President **Admiral J. H. Towers.**

Fred N. Dickerman has been named Director of Engineering, a new position in the company, by **F. O. Detweiler,** President of Chance Vought Aircraft, Inc. His old post of Chief Engineer goes to

Harvey Aluminum will reduce your costs



HERE'S HOW *one manufacturer*

CUT COSTS 62%

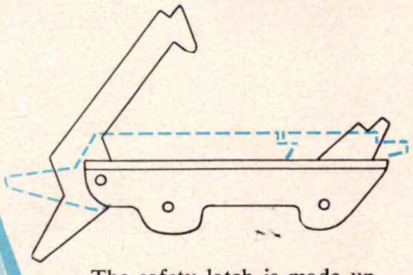
CUT MACHINING OPERATIONS 45%

INCREASED PRODUCTION 38%

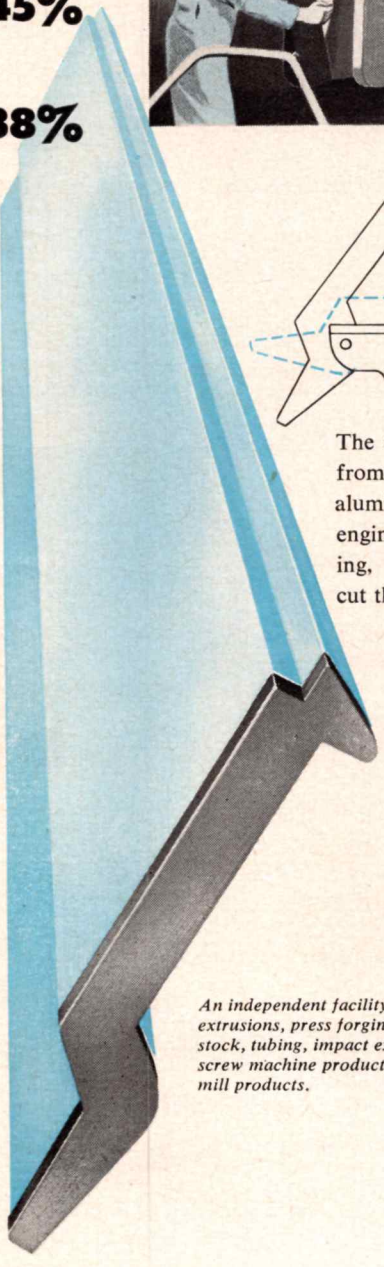
Working closely with the engineers of an aircraft component manufacturer,* Harvey engineers designed a flush-mounted safety lock for external aircraft access doors. By using aluminum extrusions rather than machining the bolt and trigger from bar stock, production costs were reduced by 62%. The use of extrusions virtually eliminated the costly machining operation and at the same time stepped up the unit rate of production approximately 38%. If you use structural metal in your business, Harvey Aluminum extrusions will help reduce your costs. We hope you'll get in touch with a Harvey Field Engineer without delay.

**Name on request*

The men at Harvey are dedicated to the idea of improving your product while reducing your costs. And remember, Harvey prepays the freight to your plant.



The safety latch is made up from the cross section of two aluminum extrusions. Harvey engineers bypassed machining, casting and forging to cut the client's costs.



An independent facility producing special extrusions, press forgings, bar stock, forging stock, tubing, impact extrusions, aluminum screw machine products, and related mill products.

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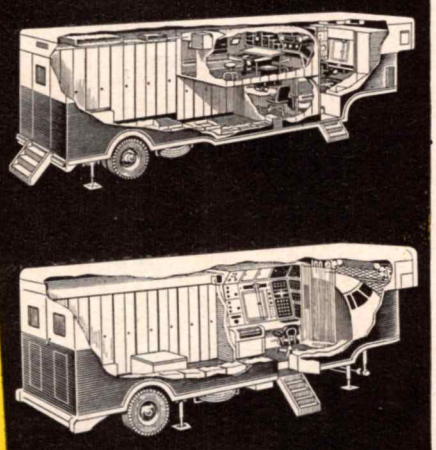
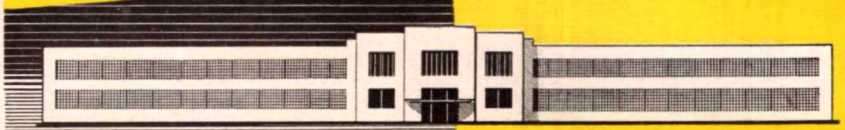
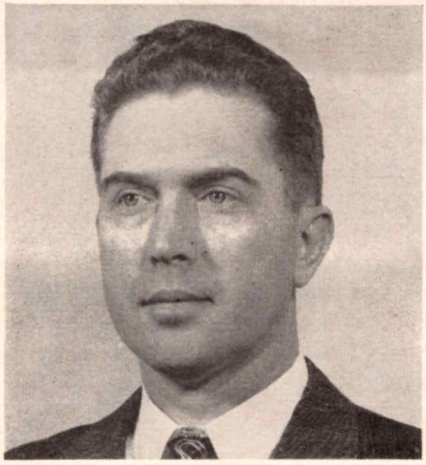




ENGINEERING and RESEARCH CORPORATION
RIVERDALE, MARYLAND

Raymond C. Blaylock, former Assistant Chief Engineer.

Leonard D. Sullivan has been named Vice President in Charge of



C. B. Wright

Sales of the Babb Company, aviation subsidiary of the Atlas Corporation.

Dr. Lewis C. Sorrell, Director of the Economic Research Division of the Air Transport Association since 1943, has left to assume the Walker-Ames Service Professorship in Transportation, Marketing and Foreign Trade at the University of Washington, Seattle.

R. W. Richardson has been named Vice President in charge of Sales for the Goodyear Aircraft Corporation, Akron.

Joel R. (Bob) Baker has been named Chief Engineering Test Pilot for North American Aviation, Inc., by **George R. Mellinger,** Chief, Engineering Flight Test Department.

James R. Kerr, former USAF colonel, has been named Director of the newly-created West Coast Division of Avco Manufacturing Corporation. END

Joel R. Baker

PLANES AT WORK

The old-time barnstormers who flew Curtiss pushers back before World War I would feel right at home in the *Pinwheel*. The pilot sits on a canvas seat and is secured to the strap-on-the-back helicopter by a waist-belt and shoulder harness. Under development for the Navy Bureau of Aeronautics by the Rotor-Craft Corporation of Glendale, Calif., the one-man helicopter is propelled by two tiny rocket engines in the tips of its rotor blades. The rocket motors, first in history to be throttle-controlled, are fed by a flameless liquid chemical fuel which is transformed into superheated gas. The gas jetting from the rockets at supersonic velocity whirls the blades to flying speed in less than 10 sec. Unlike conventional helicopters, the *Pinwheel* uses no electricity, has no oil system, hydraulic system, transmission, starter or generator. It doesn't even have foot controls—the pilot lands on his feet!

Look for first deliveries of North American FJ-4 *Fury* production models to U.S. fleet sometime next year. Deliveries will continue through 1956. Prototype (first flight: October 28) demonstrated greater range and higher performance than FJ-3. Its maximum gross take-off weight: more than 9½ tons.

The Air Force is testing the Convair YC-131C, first U.S. twin-engine turboprop military transport, a conversion of the Convair-Liner 340. Two Allison YT-56 turboprop engines developing 3750 hp each have replaced the two 2400-hp piston engines in the commercial airliner.

The *Learstar*, first production model of Lear, Inc.'s new executive airplane, is claimed to be the world's fastest production twin-engine transport. The 10-place aircraft has a top speed of 321 mph, with a non-stop cruising range of over 3,000 mi. The *Learstar* incorporates portions of the Lockheed *Lodestar* airframe structure but is essentially a new aircraft, and a prototype is in the final phase of complete CAA flight demonstrations. Production rate of two *Learstars* per month is expected by early next year.

An outstanding little racer, Steve Wittman's *Buster*, has joined the *Spirit of St. Louis* and other famed aircraft in the National Air Museum. The tiny plane, built in 1931, won two of the three Goodyear Trophy Races, placing first in 1947 and 1949, and fourth in 1948. As a class racer it set a world's record of 238 mph over a 100 km course at Detroit in 1937. During its 24-year history, it not only got a new name (it was originally named *Chief Oshkosh*) but also new wings, engines, and landing gear.

USAF now has supersonic twins for its continuing high speed, high altitude research program. The Bell X-1B has joined its rocket-powered sister ship, the X-1A, at the Air Force Flight Test Center, Edwards AFB, California. The planes are identical except for instrumentation — although each plane carries approximately the same amount—1000 lbs. Sixth and last of the X-1 series, the X-1B differs very little from the original X-1, designed in 1945.

Main differences are that the X-1B is nearly five feet longer, has increased fuel capacity and is equipped with a turbine pump to force-feed propellants to the rocket engine.

A new version of Chance Vought's F7U-3 *Cutlass*, the F7U-3 photo reconnaissance plane with five camera stations, has completed its initial tests at Dallas. A nose camera shoots forward and down, a second camera in the center station can photograph straight down or at a 45 deg. angle and in the rear station a trimetrogon installation of three cameras can be operated. The *Cutlass* carries 104 flash flares for night work which can be ejected by the pilot from the bomb bay—the plane's camera shutters open when the flare is ejected and the flash of the flare trips a solenoid which closes them. Special feature of the recon plane is a camera azimuth mount which aligns the camera with the true flight path of the plane in case of crosswind.

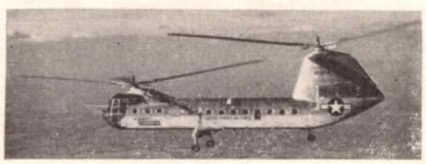
An initial quantity of Martin RB-57 light jet bombers flew the Atlantic and have been delivered to the 12th Air Force in Germany.

The Bell X-1B has recently joined its sister ship the X1-A at Edwards AFB, Calif.

Radical new feature of the RB-57 is the Martin-developed rotary bomb door which forms part of the actual fuselage bottom. Instead of opening in the usual clam-shell manner, the one-piece door loaded with bombs revolves 180 deg. to bring the internally carried explosives out for release. Trainer version, B-57C was announced late last month.

If the Douglas A3D *Skywarrior* were able to stand on its tail "pogo stick" fashion, the twin-jet bomber fully loaded could rise vertically. A3D project engineer Harry A. Nichols, says that theoretically a five-second, straight-up take-off could be made by using 12 large JATO bottles mounted on both sides of the fuselage, to supplement the plane's two J57 turbojets, each rated at 10,000 lb. static thrust. Although the A3D is the Navy's largest carrier-based plane, with JATO it can easily take off from a carrier without using a catapult.

Piasecki's giant 15-ton helicopter, the YH-16, has made its first altiture flight. Flown at speeds ex-



ceeding 130 mph and at altitudes between 3000 and 4000 ft, pilots report the helicopter exhibits very satisfactory maneuverability and control characteristics. A second and more powerful version of this 42-place aircraft, the YH-16A, equipped with two Allison shaft turbines, is now completed and undergoing engine governor testing in preparation for its initial flight.

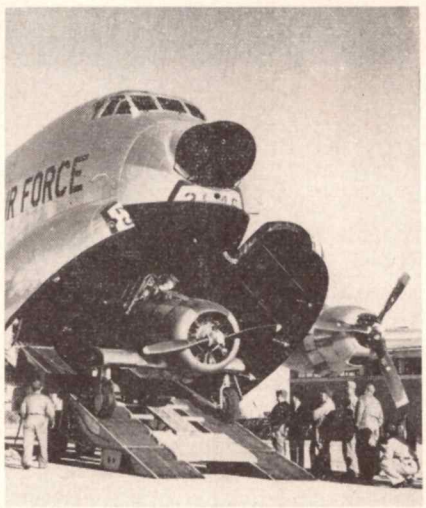
Year's end will see an initial order of Hiller H-32 *Hornets* delivered to the Army, Navy and Marines. The two-place helicopter, powered by ram jet engines weighing only 12 lbs. each, has an empty weight of little more than 500 lbs., and can lift more than its own weight. Missions performed on the ground with jeeps such as wire laying, evacuation, aerial photography and reconnaissance can be taken over by the *Hornet*.

A tremendous saving in time and money was made recently when ten T-6 *Texan* trainers were airlifted to Montevideo, Uruguay, under the MDAP. Three C-124 *Globemasters* carried the *Texans* on the 6700-mile trip, with an average flying time of slightly more than thirty hours. The project cut more than 12 days from the time normally required for the short-range planes to make the flight under ideal conditions (more than 250 take-offs and landings would have been required had the single-engine aircraft been flown individually). It is estimated that the savings of over $30,000 was made and in addition, each *Globemaster* returned to the U.S. carrying cargo from the various U.S. missions along the route.

Soon after January 1, TEMCO expects to make delivery on the first production models of the Riley 55, a more powerful and versatile version of the Riley twin-engine conversion of the *Navion*. List price for the conversion is $29,500, with the customer furnishing the airframe. Major improvements include: new 170 hp Lycoming 0340 engines which provide a top speed of 180 mph and allow a gross weight increase to 3600 lbs.; improved fuel system; new front seats and redesigned control quadrant.

The Army recently witnessed a demonstration flight of the *Paraplane II* at Fort Belvoir, Va. This unorthodox plane, built by the Lanier Aircraft Corporation, can hover as slowly as 19 mph with power, without loss of altitude. It has a top speed of 120 mph, can take off and land in 100 ft. areas, and does not stall or spin. The patented Vacu-jet device in the wing is composed of a scoop that drops from the bottom of the wing forming a variable venturi. It scoops up the air and ejects it at much higher velocities in a rearward direction on top of the wing. This device gives high lift at low speeds during steep descents—causing the *Paraplane* to act as its own parachute.

That famous old workhorse, the DC-3, has been improved again. Modification by Pan American Airways includes replacement of the regular 1200 hp R-1830 engines with 1450 hp R-2000 engines, installation of geared rudder trim



Ten North American T-6s recently flown in three C-124s to Montevideo, Uruguay

tab for reduction of rudder pedal forces, stainless steel accessory cowling, C-47 type landing gear, lighter propellers, and modified fire-fighting equipment. Dubbed the Hi-Per DC-3, the revamped airliner has a maximum gross weight of 26,900 lbs., giving the aircraft a payload increase of 1528 lbs. Speed has been upped to 214 mph at 10,000 ft. First licensing has been granted by CAA.

Production is sold out through the middle of January on the new Beechcraft C50 *Twin-Bonanza*. The C50 is the fastest airplane—with the longest range — in the standard six-place, executive aircraft field. It cruises at 200 mph at only 66.6 percent of power, at full gross load, and has a range of 1,100 mi.

An "enemy air force" attacking Jacksonville, Fla., several weeks ago was intercepted and "destroyed" by Navy VF-13 pilots flying Grumman F9F-8 *Cougars*. The *Cougars* took off from their five-minute alert station after the attacking planes — B-47's — were picked up on the radar scope and, in minutes, the interception was completed and all bombers "destroyed" by high speed gunnery runs. VF-13's commanding officer, Comdr. Landis E. Doner (who shot down nine enemy aircraft during World War II while flying an F6F *Hellcat*) said the exercise was a "complete success."

LYNN BLACK

HERE'S HELP IN PLANNING
CIRCUIT PROTECTION & CONTROL

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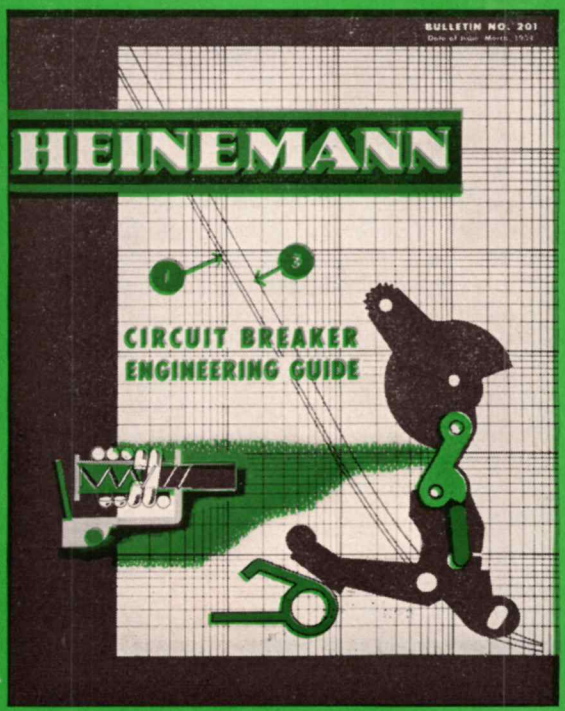

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Supersonic Autopilot

Minneapolis-Honeywell develops fast responding and accurate control system for high speed flight

A NEW Minneapolis-Honeywell electronic automatic pilot using entirely new concepts of automatic flight has been ordered by the U. S. Air Force for latest model supersonic jet fighter planes. It is designated the E-10.

The new system gives faster and more accurate control of a supersonic plane than would be possible with previous automatic control systems. It weighs only half as much as autopilots used on planes in Korea. The new control techniques, known as flight path stabilization and control stick steering, represent engineering advancements designed to meet the unique problems encountered by planes travelling at more than the speed of sound.

Flight path stabilization, company engineers explained, concerns itself with control of altitude, Mach number, and signals from navigational beams and bombing computers. Previous autopilots were usually used only in maintaining the craft in straight and level flight or in performing simple turns.

Control stick steering enables the pilot to control the plane in the normal manner through the stick in either manual or autopilot flight. Previous systems also were subject to limitations in the degree of bank, rate of turn and other maneuvers and when these limitations were exceeded the autopilot became inoperative and the human pilot had to take over.

Building block components facilitate autopilot maintenance under field conditions

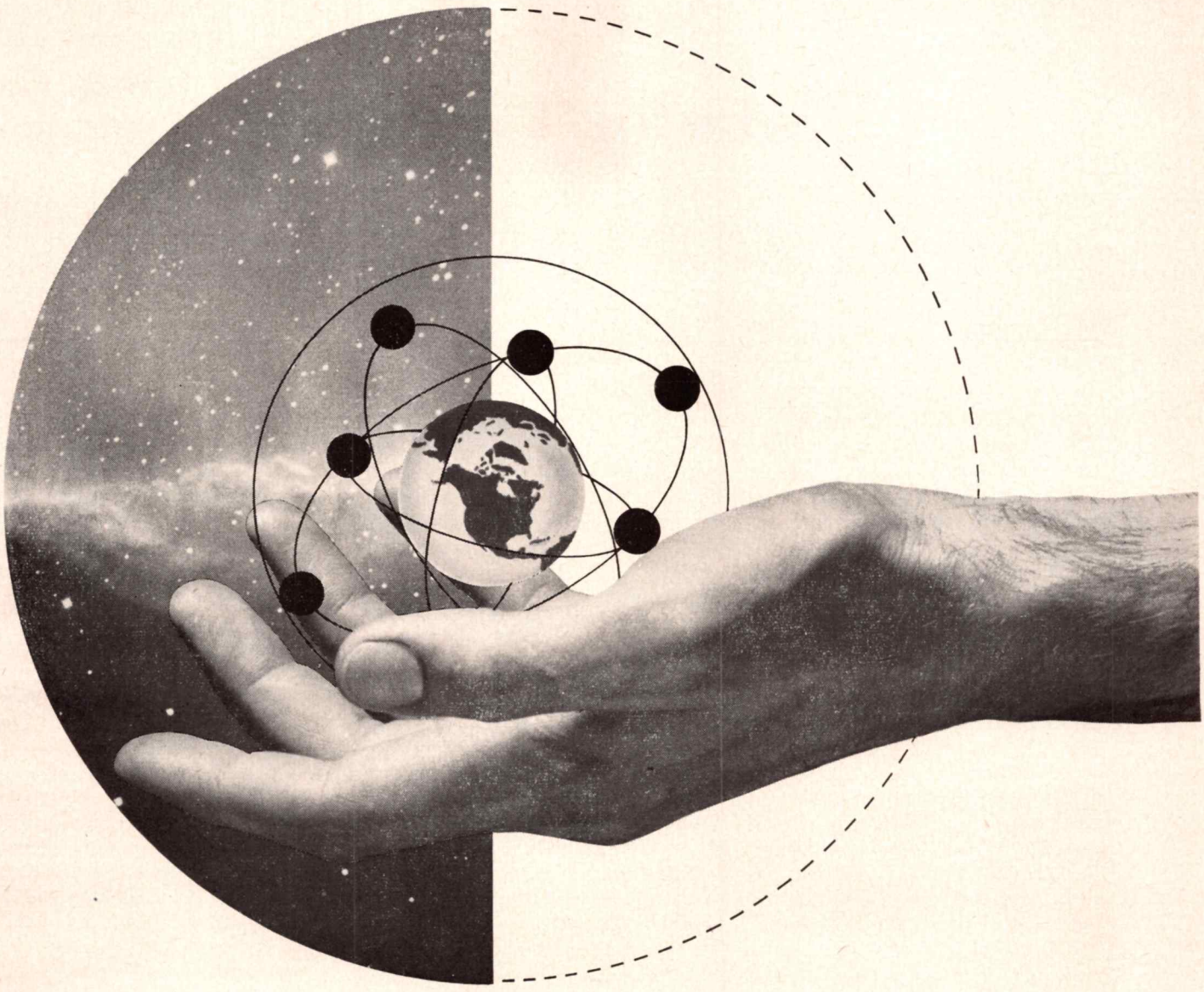
Automatic flight control of aircraft using the new system is limited only by the maneuvering capabilities of the plane and the number of Gs the pilot can stand, Keating said.

Test pilot A. J. Bailey demonstrates small size of E-10 autopilot cockpit selector panel

Control stick steering and other improvements in the new E-10 system enable all of the autopilot cockpit switches to be housed in a three-by-five-in. box. Its three selector switches permit the pilot to choose the flight functions he wishes controlled and set the autopilot with only one hand and without looking at the control box.

In addition to stabilizing the plane at speeds greater than the speed of sound, the E-10 provides automatic cruise control, regulation of altitude and airspeed and instant response to guidance commands from navigational, radar bombing and automatic fire control devices. It is possible to "tailor" the autopilot to virtually any aircraft and any type of mission—interception, level or dive bombing or long-range cruise.

A new "building block" theory also helps adapt the control system to a wide variety of uses and planes. This means the components and even the racks on which the autopilot is mounted can be plugged into the plane, are easily removable and can even be shifted from one aircraft to another under field conditions. END



brand new world

As a major development in its program of advanced design, Martin has expanded its operations into the field of atomic power.

This means that a top team of scientists, physicists and engineers is now ready at Martin to carry on a strategic long-range program in the application of nuclear energy to weapons systems development.

Yesterday, Martin took the lead in recognizing the importance of electronics, integrating this new science into its operations with engineering and development facilities second to none in the industry.

Today, the horizonless science of nuclear power has been added—again ahead of the calendar.

And tomorrow you can expect Martin to develop techniques for harnessing the potential of each new science to come.

You will hear more about Martin!

MARTIN

BALTIMORE · MARYLAND

Matador Launcher

Martin's portable "Zero Length Launcher" is self-contained unit for pilotless missile

ADDITIONAL information on the launching equipment for the Martin B-61 *Matador* missile was released by the Air Research and Development Command recently.

The launching device is a specially constructed semi-trailer called a "Zero Length Launcher," with supporting equipment. It operates in an area of only 100-ft square, without the use of a runway. Only one part of the device moves during the operation, and that, only a few inches.

The launcher was developed by the Glen L. Martin Company, and ARDC's Wright Air Development Center. It consists of a 39-ft. tandem axle semi-trailer weighing 35,000 lb. without the missile, a motor generator, blower, hydraulic pump and a wing rack. Though a self-contained unit in itself, it is supported by auxiliary equipment, such as a 28-ft., 15,000 lb. transport semi-trailer, a five-ton tactical truck tractor and a 20-ton truck-mounted crane.

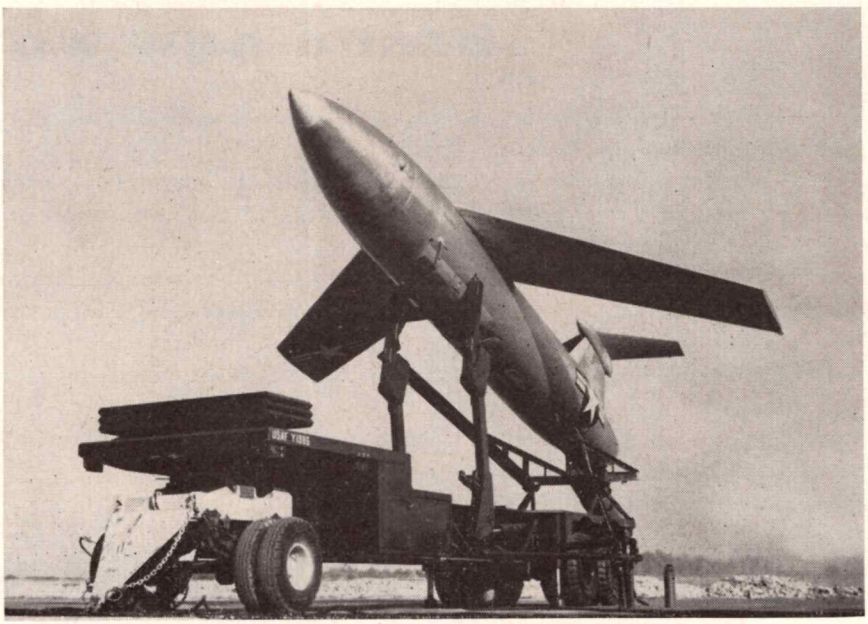
The missile is mounted on the launcher by a three-point suspension. Two balls and socket supports at the front point the weapon upward at a 15-deg. angle. The rear support is in the form of a bolt that keeps the missile from moving until full power is attained at which time the bolt shears and allows the missile to take off.

At this point the front supports swing forward a few inches and drop away from the missile. This allows clearance for the booster bottle attached to the rear of the Matador. Launching can be done from any hard-packed spot, though concrete, macadam or pierced-steel planks are prepared as a launching pad.

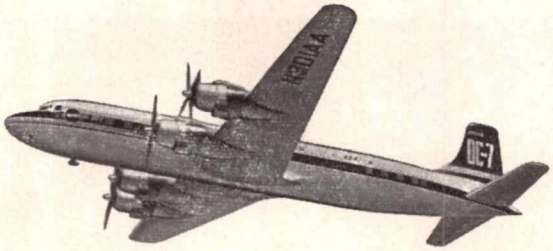
At the site, the hydraulic jack raises the front from the ground in order to make the platform as immovable as possible. The equipment is checked and a wire which controls the missile during launching is attached to its side. When the missile takes off, the cord pulls loose from its side.

After the missile engine has been started and brought up to full power, the booster bottle is ignited. The tremendous power released then serves to shear the bolt holding the rear of the missile, and the *Matador* takes off on its mission.

END



Matador shown here ready for launching on portable device that needs only 100 sq. ft. of operating space



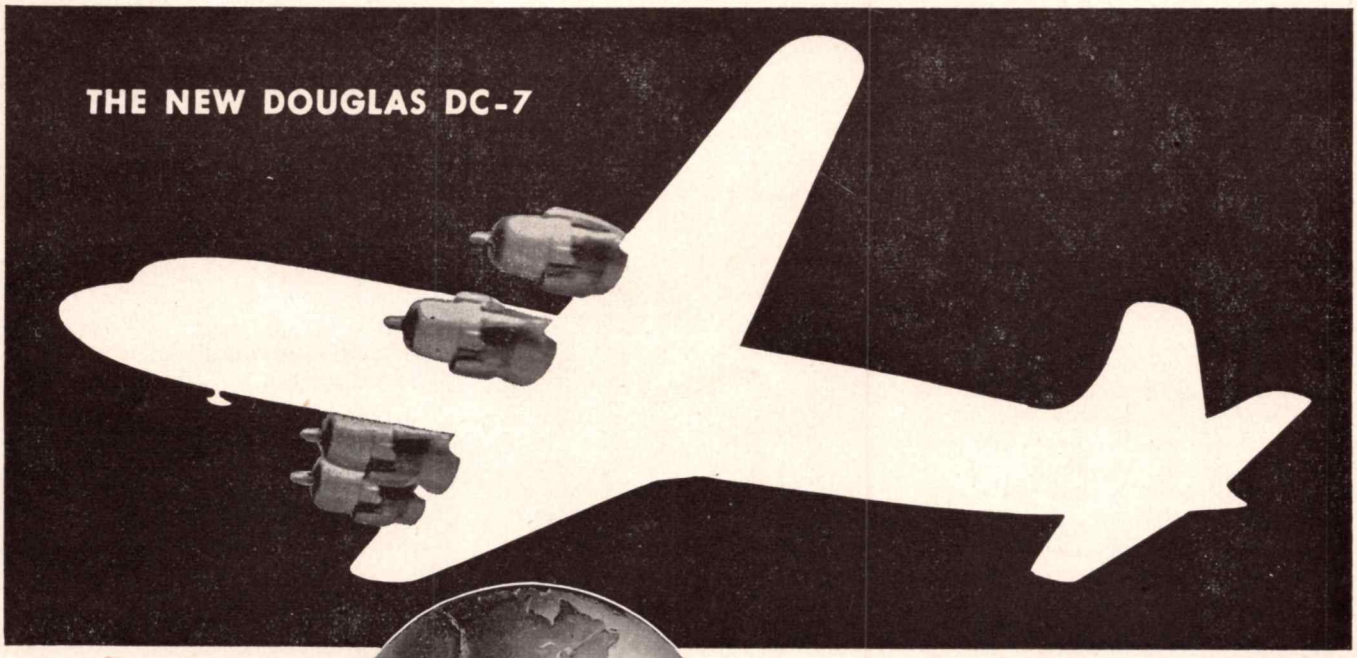
THE PROOF IS IN THE PACKAGES!

Rohr has won fame for becoming the world's largest producer of ready-to-install power packages for airplanes – like the Lockheed Constellation, Douglas DC-7, the all-jet Boeing B-52 and other great military and commercial planes.

This, we believe, is proof of Rohr's engineering skill and production know-how. But it's not the whole story.

Currently, Rohr Aircraftsmen are producing over 25,000 different parts for aircraft of all kinds... many of these calling for highly specialized skill and specially engineered equipment.

Whenever you want aircraft parts better, faster, cheaper – call on Rohr. The proof of engineering skill and production know-how is in the thousands upon thousands of power packages that have made Rohr famous.



WORLD'S LARGEST PRODUCER OF READY-TO-INSTALL POWER PACKAGES FOR AIRPLANES *-RECIPROCATING, TURBO-PROP, TURBO-COMPOUND AND JET.*

ROHR
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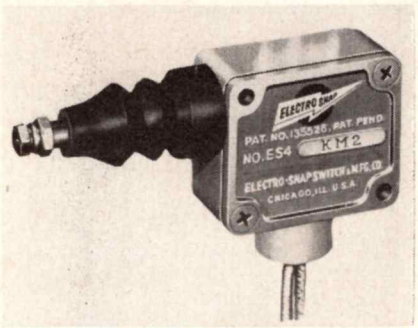
CHULA VISTA AND RIVERSIDE CALIFORNIA

NEW EQUIPMENT

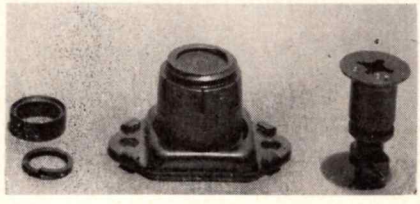


One-Way Impulse Switch

The new Electro-Snap switch is finding wide application in the pneumatic and hydraulic control fields where it is used to operate double solenoid valves. When actuated, it sends a short electrical pulse and then is out of the circuit. Sequencing can be carried out without an additional interlock switch to open the impulse circuit. Automatic machines can run faster because cycles can be more closely sequenced. One-way dogs can be eliminated, and special cams and long actuating travel are not required.

The switch has a high capacity Electro-Snap basic switch enclosed in a die-cast case. A linear actuator to operate the switching mechanism is integral with the case. The totally enclosed actuator mechanism extends the overtravel characteristics of the basic switch. The plunger is equipped with an adjusting screw to vary the plunger length; adjustments up to ¾ in. can be made with the switch in place.

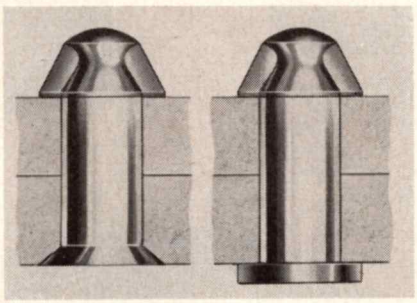
Electro-Snap Switch and Mfg. Co., 4220 W. Lake St., Chicago 24, Ill.



Fastener

The National Aircraft Standards Committee's Specification NAS 547 calls for a high strength, quick release, rotary-type, stud-and-receptacle fastener capable of carrying structural loads in shear and tension with minimum deflection. Scovill worked for over two years on the development of its Paneloc fastener which exceeds the ultimate specification loads. Two types are now available—stud-retained and curvature-adaptable; they open and close with a quarter turn, are offered in size No. 2 of the specification, 7300 lb. ultimate shear load, and class I (550 deg. F.). The fastener provides stud retention with the use of a shear washer and retaining ring. When stud retention is not essential, these parts may be eliminated. Using a completely assembled receptacle ready for attachment with two rivets, it has stud ejection to indicate an unlocked fastener. Available with or without full float, the receptacle can be capped for pressure sealing. It is also adjustable with any stud length for sheet pick-up up to ⅛ in. in size No. 1, and 1/16 in. in size No. 2, thus making a large inventory of studs unnecessary.

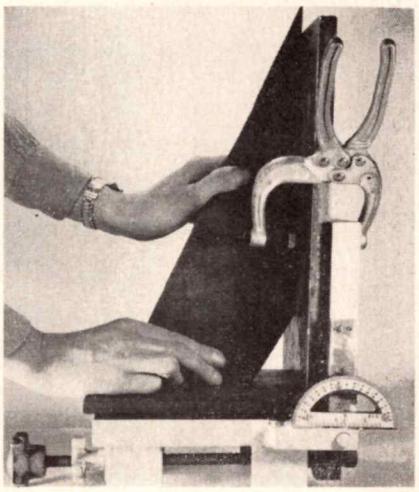
Aircraft Fastener Div., Scovill Manufacturing Co., Waterbury 20, Conn.



Titanium Rivets

Advantages of titanium are added to those of Hi-Shear rivets in a new aircraft structural fastener announced by Pheoll, prime licensee on High-Shear rivets, a patented development of North American Aviation, Inc. Pheoll Hi-Shear rivets made from C-130AM titanium alloy offer a 40 percent weight saving over the same type rivets in alloy steel. They have a minimum shear strength of 95,000 psi, and can replace high-heat-treat alloy Hi-Shears without decreasing structural strength. No protective finish or lubrication is needed. These rivets also retain useful strength at elevated temperatures from 800 to 1800 deg. F.

Pheoll Manufacturing Co., 5720 W. Roosevelt Road, Chicago 50, Ill.

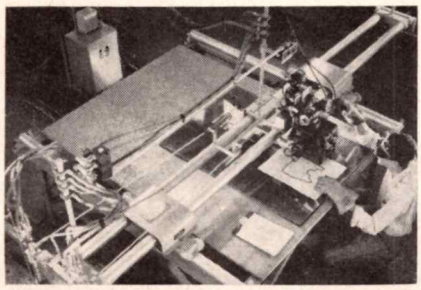


Angle-Forming Jig

In tooling for production of the Boeing B-52 *Stratofortress* fuselage sections, as many as 2000 angles are used in a single jig. Sides of these angles range up to 22 in. long, almost twice the length of the largest standard stock angle. Many of the angles are now formed quickly and precisely on a newly developed weld and check fixture which saves an average of five manhours per jig by simplifying the positioning and welding of open and closed angles and gussets.

Woodrow W. Keas of TEMCO designed the weld and check fixture, and built it in less than four hours. The fixture has a back plate and a bed plate, each made of 10 x 10-in. pieces of 1-in. cold rolled steel. Four feet, welded to the bed plate, are 3 x 3 x 2½-in. angles. Plates are hinged together by two 1 x 1 x 3-in. hinges, welded to the bed plate, and joined to the back plate by two ½ x 1½-in. dowels. This permits opening and closing the angle formed by the back and bed plates.

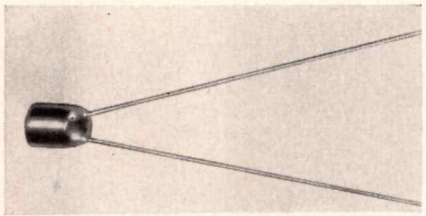
Regulation of the closure is by a ½ x 13-in. threaded bolt running horizontally through a block welded to the bottom of the bed plate, and through a swivel block secured by dowels to the bottom edge of the back plate. Two star nuts are attached to the front end of the bolt. The fixture operator turns one nut to tilt the back plate to form any angle from 30 to 180 deg., and turns the other to lock the back plate at the desired angle. Angles formed by this method are true to within one degree.



Shape Cutting Machine

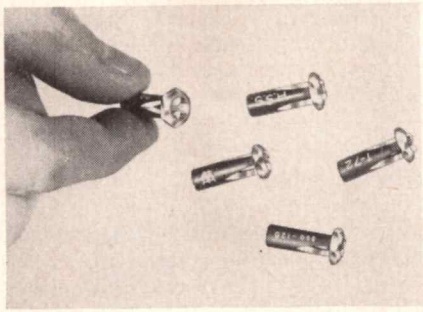
The Airco No. 48 Duograph is a rectilinear-type, medium area, oxy-acetylene shape cutting machine with four torch capacity. Torches may be arranged in a wide variety of positions—two at each end of the machine, four on one end, either mounted transverse or parallel to the cross rails. Cutting range when equipped with one tracing table is 48 in. wide by 51 in. long. Four 48-in. diameter circles can be cut simultaneously with two torches at each end of the machine. Cutting length can be extended indefinitely by the addition of extra tracing tables, each additional table extending cutting length 80 in. Different tracers—electronic (using low-cost paper cutout or pen-and-ink drawing templates), magnetic and manual—can be used and are readily interchangeable on the machine. Controls are grouped at the "operator's station" for automatic lighting of torches, turning gases off-and-on individually, tracer operation, and raising and lowering torches. Torches are equipped with pilot light assemblies and remote control extensions for raising and lowering. Outlet on the solenoid gas distribution system provides for connecting four torches. Six in. thick steel can be cut with four torches operating simultaneously.

Air Reduction Sales Co., 60 E. 42nd St., New York 17, N. Y.



Sub-Miniature Resistor

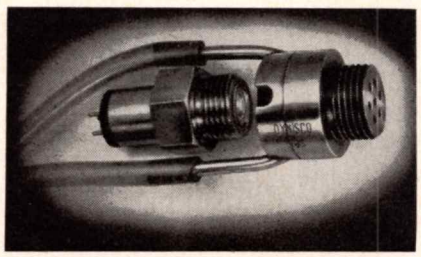
Daven Type 1273 sub-miniature encapsulated resistor is ¼ in. in diameter by 5/16 in. long, and can be supplied with up to 400,000 ohms maximum resistance. Mounting is by radial leads, and power rating is 0.1 watt. Meets all humidity requirements and can be supplied with any type resistance wire depending upon the temperature coefficient required. The Daven Co., 191 Central Ave., Newark 4, N. J.



Adjustable Threading Dies

A self-contained adjustable threading die has recently been developed by Woodruff & Stokes Co., Inc. The threaded outside diameter of the cutting edge of the die permits simple and positive adjustment of a hex collar so that thread diameter may be varied over a range of .004 in. Once set, the die will not change under the severe conditions of turret indexing. The collar also permtis easy removal of stock broken within the die. The adjustable threading dies are available in high speed and carbon steel, in sizes from 2-56 to 0000-360 with various pitches including metric variations.

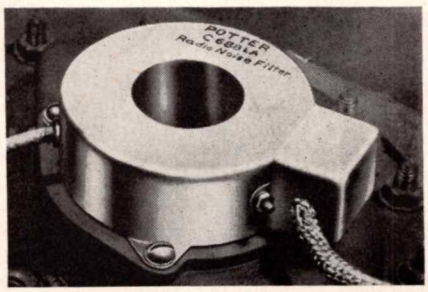
Woodruff & Stokes Co., Inc., 353 Lincoln Street, Hingham, Mass.



Water-Cooled Adaptor

For pressure measurements at temperatures up to 4000 deg. F., a new, water-cooled adaptor for standard pressure pickups has been developed by Dynamic Instrument Company, Inc. Cooling adaptors are available to receive either threaded or flanged Dynamic pickups having sensitive diaphragms of 9/16 in. or ¼ in. diameter. No modification of the pickup is necessary. The adaptor has a ¾ in.-16 threaded mount, and its small size facilitates use in small tubes and manifolds. Both adaptor and pickup have cases of corrosion-resistant stainless steel. The new Dynamic adaptor has a number of small tubes through which gas or fluid pressure passes to reach the sensitive diaphragm of the pressure pickup. Cool tap water is circulated through a jacket which encloses the adaptor tubes. The hot fluid or gas is cooled in the adaptor tubes before it comes in contact with the pressure pickup. The adaptor tubes are sufficiently short in length so that pressure variations, at frequencies up to 3000 cps. are transmitted to the pickup without appreciable phase shift. Cooling water is supplied to the adaptor through ¼ in. rubber hose.

Dynamic Instrument Company, Inc., 28 Carleton St., Cambridge, Mass.

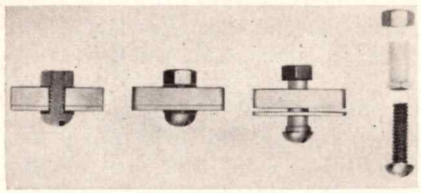


Radio Noise Filter

A new Potter radio noise filter for fuel booster pumps is space saving and weighs only 11½ oz. Center hole design permits access to the drain plug of the pump. This 20 amp. continuous duty filter is engineered to comply with the noise limits set forth by Spec. Mil-P-5238, and meets environmental and vibration requirements of Spec. Mil-E-5272A.

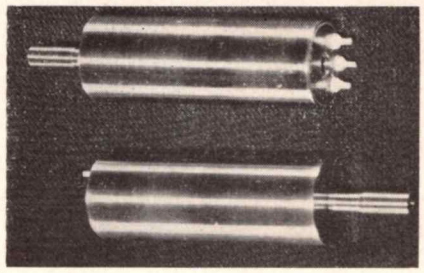
The Potter Co., North Chicago, Ill.

ACKNOWLEDGMENTS (left to right, top to bottom) 5—Convair Division, General Dynamics Corp. 7—North American Aviation 8—Rotor-Craft, Inc. 12—Chance Vought, Inc. 23-24—Hydro-Aire, Inc. 31-35—Curtiss-Wright Corp. 36—Convair Division, General Dynamics Corp.; Narmco Manufacturing Co. 38-40—Narmco Manufacturing Co. 44—Department of Defense 56—Tenney Engineering Inc. 60—Universal Equipment Co. 65—Bell Aircraft 66-Piasecki Helicopter Corp.; North American Aviation 68—Minneapolis-Honeywell 70—The Glenn L. Martin Co. 86—Wright Aeronautical Corp. 92—Lockheed Aircraft Corp.



Nylon Sleeve for Fastenings

Nylite, a fastening which reduces bolt failure due to vibration, eliminates electrolytic corrosion, and provides a leakproof seal, has recently been announced. The new item is a nylon sleeve which uses nylon's cold-flow properties for improved fastening and sealing with bolt, screw or rivet. A nylon washer providing sealing is formed when a length of sleeve is used under the head of the bolt, screw or rivet, providing a seal against hot oil, cold, moisture and weather conditions. A compressible sleeve which insulates bolt and nut from work material, while serving as lock-washer and positive seal, is another basic application. Nylite can be obtained in an almost unlimited range of diameters, lengths and wall thicknesses to suit specific job requirements. Keystone Plastics, Inc., 2331 Morris Ave., Union, N. J.



High Temperature Transducers

The Crescent linear transducer is used to measure linear motion, relative displacement, position and vibration. It may be used as a remote or local transducer to examine magnitude or rate of motion, stress tests and absolute measurement of large or very small dimensions, or relative positions. It may be used in ovens, in hot fluids (if tubing cable conductor is used), or for other applications where the transducer must be mounted or operated in a region of elevated temperatures. When operated below 1300 deg. F. no cooling is required and the temperature of the entire instrument may be raised to the ambient temperature. The instrument has the following features: May be operated at temperatures between minus 160 deg. F. and plus 1300 deg. F. Linear ranges available from 1 in. to 32 in. Resolution of all models—.000,000,1 in. Operating sensitivities to 5 v. per in. Linearities to .1 percent of linear range. Simple design and heavy construction prevent damage from shock or mistreatment. No force required for displacement of sensing probe.

Crescent Engineering & Research Co., 14828 Arrow Highway, Baldwin Park, Calif.

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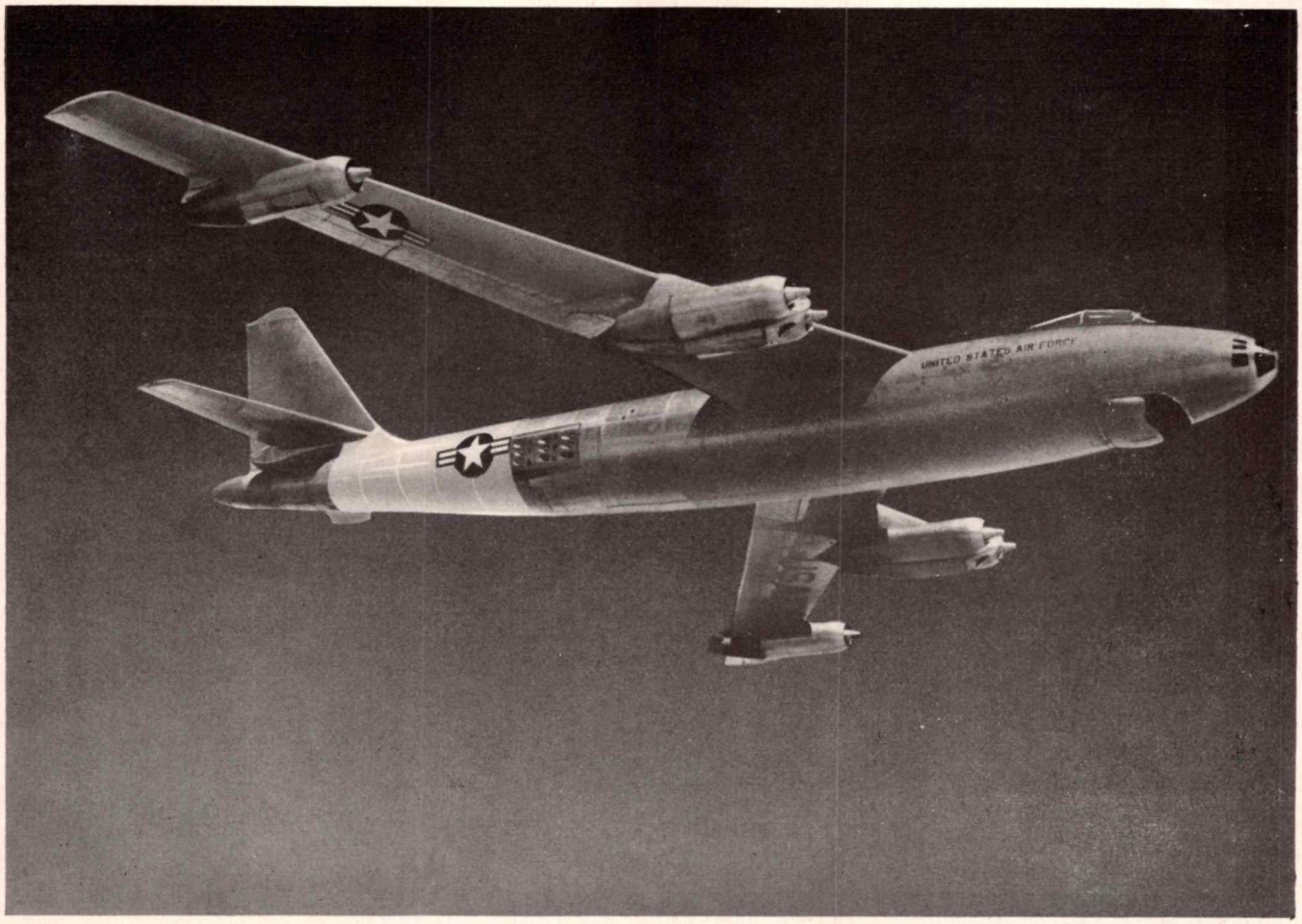
High Speed Thread Broaches

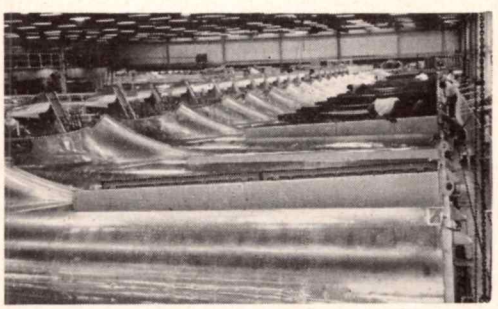
The new Shearcut taps cut tapping time and labor cost from 25 to 75 percent because of the higher rotational speeds permitted. They require less than half the power required for ordinary taps, and operate at speeds



How TEMCO helps Boeing build B-47's

Thousands of man-hours of TEMCO's production skill are incorporated into the famous Boeing Stratojets performing so sensationally around the globe today. For over three years, TEMCO has been delivering aft fuselage sections to Boeing, Wichita. Proud to be associated with such an outstanding aircraft builder, TEMCO believes that such cooperation within the industry is a big factor in the Nation's defense potential.

Boeing is but one of the industry leaders relying upon TEMCO to help simplify production. Current contracts also include fabrication of major components for Convair, Lockheed, McDonnell, and Republic. TEMCO earned these contracts because of its established reputation for delivering a quality product, on schedule, at one of the lowest costs in the industry.

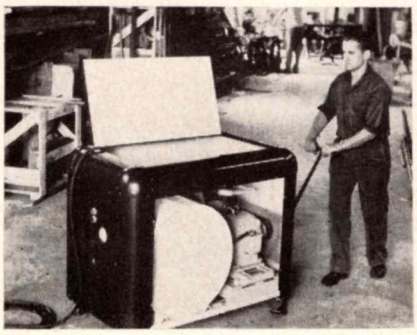


Rear fuselage sections for the B-47 Stratojet have been rolling from TEMCO's assembly lines since 1950. On the overhead conveyor assembly line shown above, final equipment items are installed in the components.

TEMCO®
AIRCRAFT CORPORATION
DALLAS, TEXAS

three to six times the normal tapping speeds used for conventional taps. Made from high speed steel, they are available in all standard sizes and pitches. Different from regular taps in design and appearance, it feeds a solid chip out of the hole being tapped. Due to low power required and to their broaching action, the taps have exceptionally long useful life, may be resharpened on any tool and cutter grinder, and no special tools or fixtures are required.

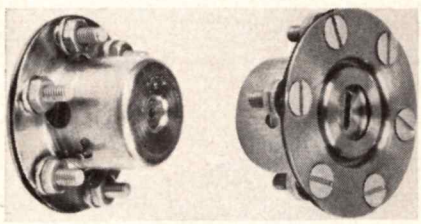
Shearcut Tool Co., 7045 Darby Ave., Reseda, Calif.



Movable Vacuum Pump

The VacForm mobile pump wagon is housed in a metal cabinet with removable panels, mounted on a steel frame with a swing-back top-door opening. It is connected by a heavy-duty hose to whatever equipment is to be used in the vacuum application and can be used at numerous spots within a single plant. The unit includes an air-cooled rotary pump with automatic lubrication, a vacuum gauge, and an adjustable vacuum shut-off switch. The amount of vacuum to be created can be controlled, with a potential up to 29½ in. at sea-level pressure. The pump's 50-gal. welded surge tank has a bottom drain. A thermal overload protection is provided for the motor and an exhaust filter eliminates the need for either an indoor or outdoor vent.

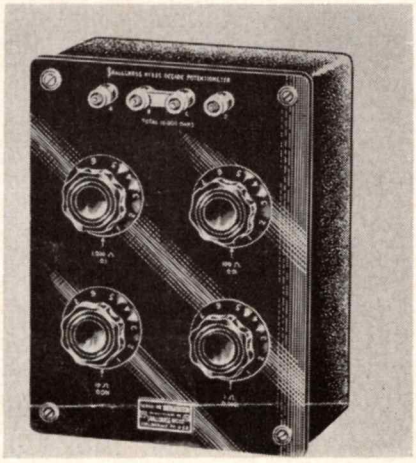
Vacuum Forming Corp., 76 S. Bayles Ave., Port Washington, L. I., N. Y.



Fuel Tank Drain Valve

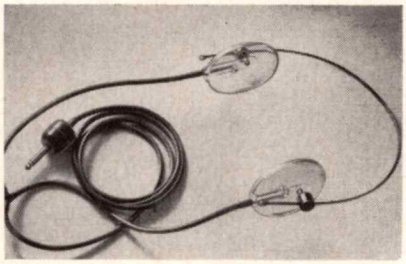
Designed for rapid draining from the bottom of a tank, a new type water drain valve for fuel tanks has been developed by The Steel Products Engineering Co. Built of stainless steel and using a replaceable 0-ring seal, it is self-closing and positive in operation. It is flush mounted and has a thin flange (built to customers' requirements). It is 2 5/16 in. in diameter and 1⅛ in. deep.

The Steel Products Engineering Co., Springfield, Ohio.



Decade Voltage Dividers

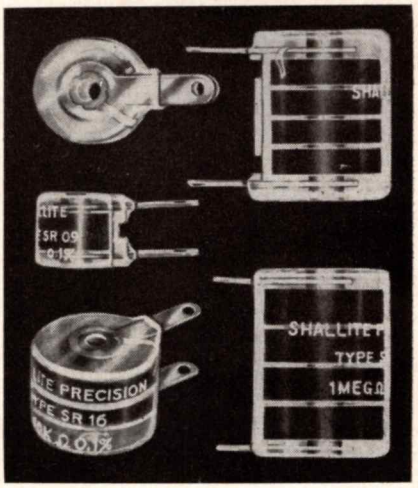
Laboratory-type decade voltage dividers, using the Kelvin-Varley circuit, have been announced by Shallcross. Types available have total resistances of 100, 1000, 10,000 and 100,000 ohms with up to 6 dials for the two higher resistance values. The 6-dial dividers provide a minimum output-to-input ratio of 1 to 1,000,000. The Model 8350 has four dials permitting 10,000 definite increments of the input voltage at the output terminals. Output resistance varies from 0 to 10,000 ohms while the input resistance remains constant at 10,000 ohms. The circuit used eliminates contact resistance errors, making these dividers especially suited to precise high voltage measurement with a low voltage precision potentiometer. Shallcross Mfg. Co., Collingdale, Pa.



Light-Weight Headset

A 1.6 oz. headset has been announced by Telex. It has sensitive plug-in mechanism, thin stainless steel band that slips over the head and two clear plexiglass air cushions. The cushions slide on the band, adjusting to the correct length, and a ball and swivel joint at the base of the cushions permits adjustment to the ear. Sound (transmitted from the receiver in the plug) is piped into the cushions through plastic tubing. Impedance of the standard unit is 128 and 2,000 ohms; special impedances can be provided on request.

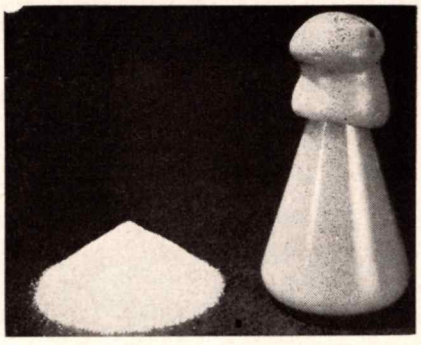
Telex, Inc., Telex Park, St. Paul 1, Minn.



Transparent Resistors

The visibility feature of the Shallite precision wirewound resistor, resulting from the transparent encapsulation, assists in precluding service failures due to internal strains. Other improvements include mechanical fastening, electric welding of all wire, leads, and the phosphor bronze terminals, all completely visible for inspection. Designed to meet the requirements of Government specifications JAN-R-93 and MIL-R-93A.

Shallite, Inc., 10 Mill St., Paterson 1, N. J.



Ready-Mix Foaming Powders

Now available from Dow Corning is a series of expansible resins for silicone foam structures. They are in

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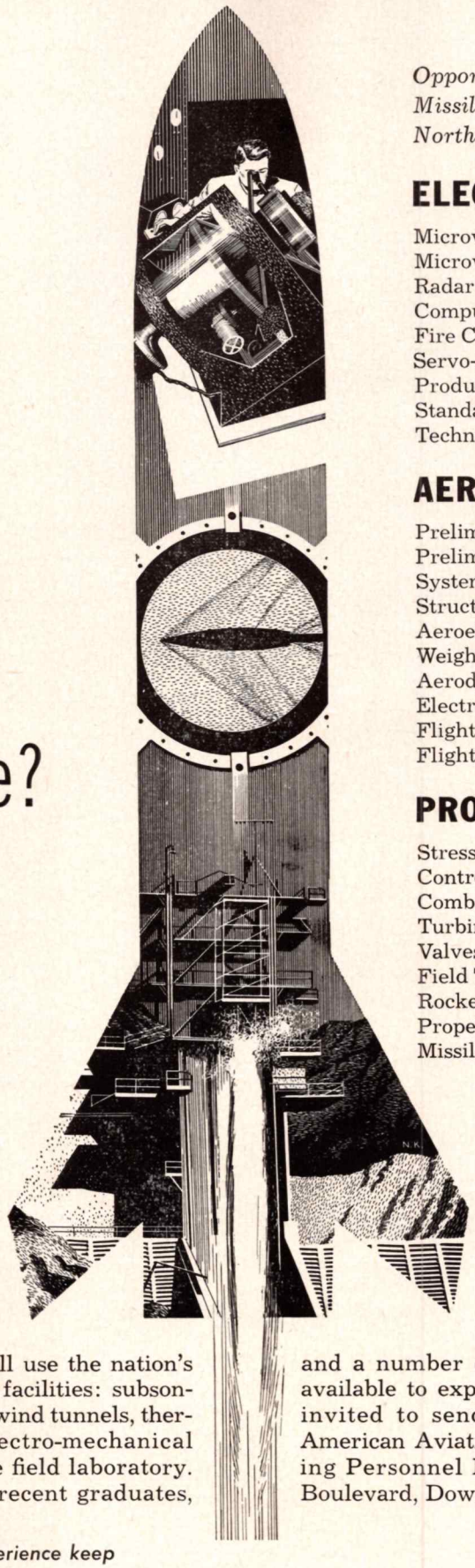

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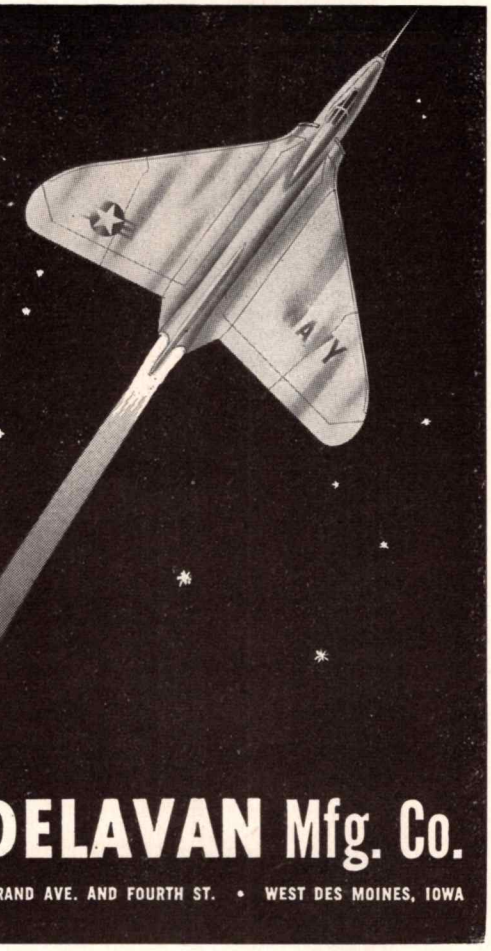

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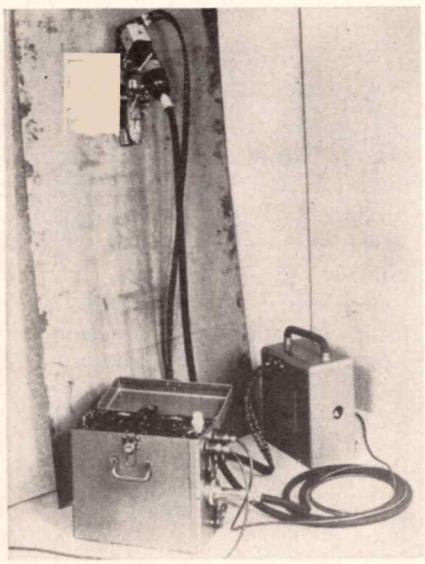
the form of ready-mix powders containing pre-measured portions of resin, filler, blowing agent and catalyst. When heated, the mixes melt, foam and cure by themselves. No further mixing or processing is required. Nontoxic, easily handled and unaffected by humidity or atmospheric pressure, the mixes can be cast into sheets or blocks, made up as sandwich structures, or foamed in place.

Dow Corning Corp., Midland, Mich.



Portable Stress Analyzer

A portable stress analyzer using the X-ray diffraction method is available for field and plant operations. Known as the "Androscope," it measures the magnitude and sense of residual stresses in metals, plastics and other materials. It transfers practical non-destructive residual stress measuring from the laboratory to the field, and is easily operated. The device distinguishes between tensile and compressive stresses which are recorded on film in 10 to 20 minutes. Rapid comparator provides quantitive measurement. Magnitude of stress PSIs is determined from a simple formula using the figure from the comparator.

Holger Andreasen, Inc., 703 Market St., San Francisco, Calif.

Ground Support Power

Power for aircraft ground support is available in the compact, self-pro-

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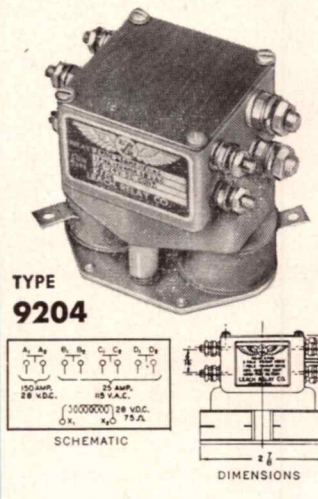

OPERATING CHARACTERISTICS

RATING:
SP-NO, 150 Amps. @ 29 VDC.
3P-NO, 25 Amps. @ 115 VAC, 400 Cycles.

RATING:
2P-NO, 100 Amps. @ 29 VDC.
2P-NO, 25 Amps. @ 115 VAC, 400 Cycles.

CONTACTS: 4PST—DB-NO
COIL: 24-28 VDC, continuous duty.
Pick-up 18 VDC max.
Drop-out 7 VDC max.
Temperature range —55°C to +120°C.
WEIGHT: 1.2 lbs. approx.

In airborne electro-mechanical components, *Leach* high quality makes the difference. Whether you're racing with sound up in the stratosphere or making a final approach to a landing strip at sea-level, it's reassuring to know that you have the most efficient, most reliable controls built. It is for this reason that more military and commercial aircraft incorporate *Leach* Relays and Contactors than any other make. They are produced to rigid aircraft standards.

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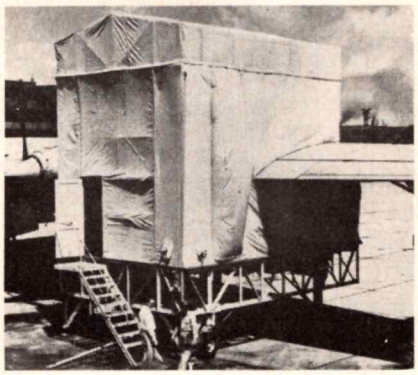
pelled, multi-purpose unit developed by Consolidated Diesel Electric Corp. Designated MA-1, these vehicles are being delivered to U.S. Air Force bases throughout the country; a Navy Bureau of Aeronautics contract has been completed. The units provide ac, dc, hydraulic and air power from a single source for starting, servicing, testing and towing. A number of models have been built and tested to meet various power combination requirements. They have all-wheel drive and mechanical transmission of torque converter. The vehicle can tow a load of up to 60,000 lb. and has a turning radius of 18 ft.

Consolidated Diesel Electric Corp., Ludlow & Canal Sts., Stamford, Conn.



B-36 Shelter

For servicing B-36 aircraft, a new mobile "wrap-around" J-2 maintenance shelter has been developed for the USAF by the Luria Engineering Co. Mounted on four wheels equipped with pneumatic tires, it can be installed by a crew of six on any of the B-36 engines in five minutes under normal conditions.

The shelter consists of a structural steel framework with corrugated aluminum roof and sidewalls covered with nylon fiberthin. It is about 23 ft long, 16 ft. wide and 28 ft. high. A weather-tight closure is provided when the curtains are buttoned around the wing, nacelle and undercarriage. The design allows for changes in wing and engine elevations, as well as for flap operation, and permits removal of an engine or propeller while the shelter is in position. A manually operated stairway and ramp provides access to the wing and to an adjustable platform. Platforms and stairs can be retracted to permit a 360-deg. rotation of the propeller within the shelter after removal of two floor panels.

Equipment is provided for flood lighting work areas, and the electrical system can be connected either to a portable power source or to a permanent power line. END

Explosion Suppression Systems Installed in New Aircraft

Explosion suppression is the new technique which has been called "a wet blanket for aerial blow-ups," and is designed to provide protection against explosions resulting from the ignition of fuel/air mixtures, most common single cause of the loss of combat aircraft.

IN operation, explosion suppression systems utilize data determined by the original research—namely, that in any fuel/air explosion there is, in the initial stages, a slight but measurable time lag during which the incipient combustion can be snuffed out and/or made relatively harmless.

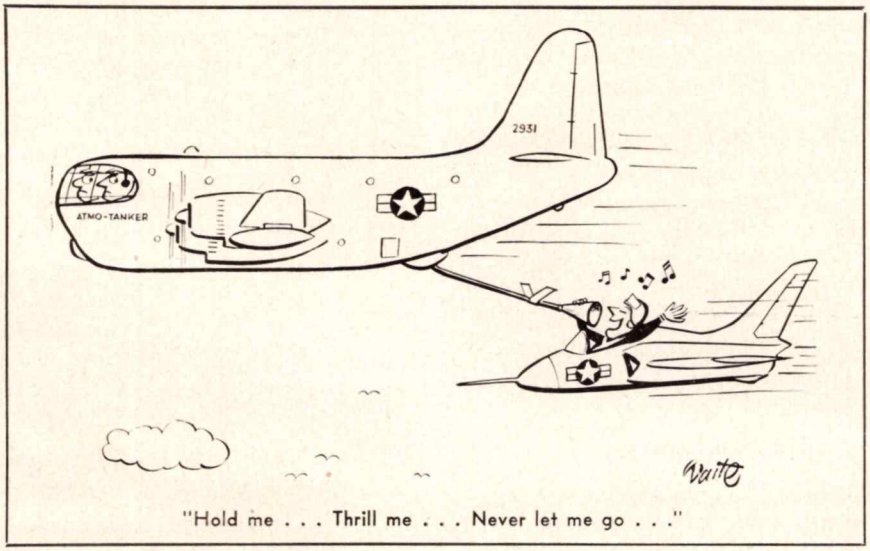
Basic elements of the system include a sensing element designed to detect the incipient combustion. This detector is connected by an electrical circuit to one or more capsules containing a suppressant fluid. When the detector senses the explosion, the circuit closes and the capsules detonate, scattering a mist which suppresses the combustion, or extinguishes a fire in its early stages.

Each system is designed to meet the requirements of an installation, and may serve to protect against single explosions or multiple explosions. There are two types of detectors, a visual type and a pressure-rate-of-rise type, depending on the requirements of the particular installations.

Development of this invention goes back prior to 1949, with the original work into the characteristics of explosions conducted at England's Royal Aircraft Establishment by W. G. Glendinning and A. M. MacLennan. In 1951 these scientists visited the U. S. under the sponsorship of the British Government to make their invention known to the aircraft industry, the Air Force and to CAA officials.

The British government grants inventors the commercial rights of their device in aircraft and industrial fields. In turn, the inventors have contracted the development and manufacturing rights of their explosion suppression systems to Graviner Manufacturing Co., Ltd., of England, for whom Simmonds Aerocessories, Inc., is sole U. S. licensee.

In the past few months, installations of explosion suppression systems have been completed on three advance type U. S. aircraft by Simmonds, working in conjunction with the airframe manufacturers. END



"Hold me . . . Thrill me . . . Never let me go . . ."

Radio Aid for 'Copters

AN electronic navigation system which solves a major problem in all-weather helicopter service will be manufactured by the Pacific Division of Bendix Aviation Corporation.

The versatile navigation system, called the Decca Navigator, was developed in England and is now widely used in northwest Europe. It will be engineered to U. S. requirements and built in this country under an agreement between Bendix and the Decca Navigator System, Inc.

Operating on low-frequency radio waves which hug the surface of the earth, the Decca System will permit helicopters to pinpoint their positions instantaneously while flying around city skyscrapers, mountains and other obstacles.

To serve metropolitan areas such as Los Angeles, Chicago or New York, the system would require a "chain"—consisting of four ground stations approximately 70 miles apart. Each "chain" would blanket an area of some 125,000 square miles with continuous-wave radio signals, which interlace, forming a grid pattern. These signals would be received by airborne equipment, automatically compared and presented to the pilot as a continuous "motion picture" of his course and position by means of a line traced on a moving map or "flight log."

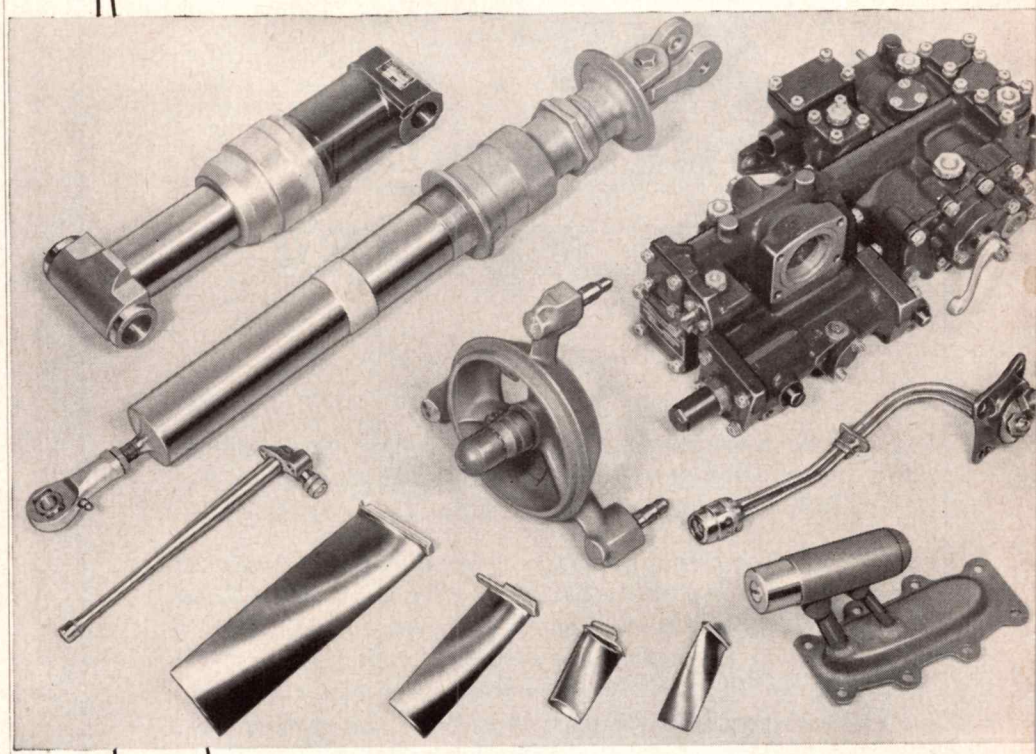
Bendix-Pacific will build under government and industry specifications both the transmitting, or ground, equipment, and the airborne receiving equipment.

A helicopter installation of the Navigator System, including the "flight log" automatic plotter plus instrument position indicators, is expected to weigh about 36 pounds.

A multi-million dollar plant at East Alton, Ill. for Olin Mathieson Chemical Corp. to put their new roll-bonding metal fabrication process on a mass production basis, will be in production before the year is out.

Jet Parts and Assemblies

TO YOUR SPECIFICATIONS



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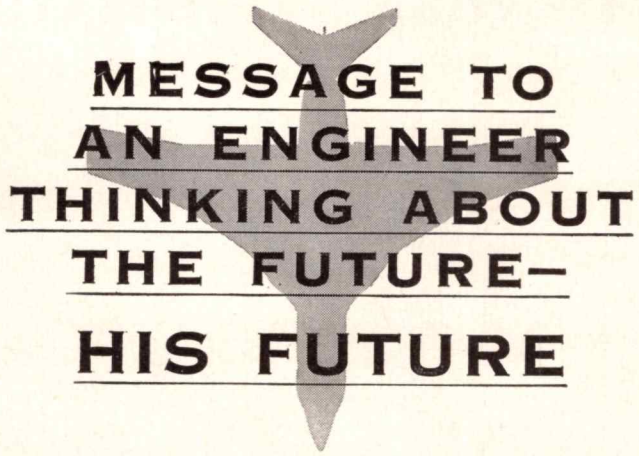


MESSAGE TO AN ENGINEER THINKING ABOUT THE FUTURE— HIS FUTURE

Take a few moments now to review the progress of your career. Does your present position offer you a future that fully utilizes your creative abilities?

Compare your present assignment with the diversified, stimulating pursuits that increase the inventive challenge of Fairchild's team of qualified engineers. These men are working on engineering advances for the famous C-119 Flying Boxcar and the soon-to-be-produced C-123 Assault Transport. More than that, they are developing tomorrow's jet fighters . . . special reconnaisance aircraft . . . jet bombers and transports. The men at Fairchild know that *planned* project diversification keeps them in the forefront of the field of aerodynamics.

Gracious country living only minutes away from urban Baltimore or Washington . . . paid pension plan . . . an excellent salary with paid vacations . . . ideal working environment . . . generous health, hospitalization and life insurance . . . and the many other benefits of a progressive company add to the pleasure of working with Fairchild.

You'll be investing wisely in a secure future if you take time today to write to Walter Tydon, Chief Engineer, outlining your qualifications. Your correspondence will be kept in strict confidence, of course.

ENGINE AND AIRPLANE CORPORATION
FAIRCHILD
Aircraft Division
HAGERSTOWN, MARYLAND

Ford's Jet Production

Ford Motor Company's Aircraft Engine Division shipped its first production model J-57-7, with afterburner recently.

"Our first production J-57-7 has been consigned to North American Aviation for use in an F-100 Super Sabre Jet fighter," said A. C. Moore, general manager of the division. Moore also said that the division's Air Force contracts for J-57 production now extend into 1957.

The division shipped its first production J-57 last April after tooling for manufacture for more than 18 months. While tooling was underway it also kept up production schedules on the R-4360 Pratt and Whitney Wasp Major. The division delivered 3,079 Wasp Majors before that contract was completed last August.

United's Airdock

An Airdock which could revolutionize present methods of loading and unloading airliners has been successfully tested in a full scale mock-up at the Denver Operating Base of United Air Lines.

In trials with a DC-6B, the plane was emptied of passengers and its dummy load of mail, baggage, express and freight in only four minutes. These results are regarded as a rough approximation of unloading time which would be achieved under actual operating conditions.

Experiments with the mock-up reliably indicate that a fully installed Airdock would eliminate most of the mobile ground equipment now used in servicing aircraft. This includes gas trucks, baggage carts, tractors, power units, oil and ADI carts, air conditioning units, sanitation carts, mobile belt conveyors and passenger loading stands.

As evident in the mock-up, the Airdock reverses traditional ramp procedure. The aircraft become the mobile element while their servicing facilities are stationary. Instead of bringing items to a parked plane, the plane is towed into the Airdock where all items are available at fixed locations.

In its present stage the mock-up has only a working minimum of parts. They consist of a passenger bridge, a sorting table for baggage and cargo, a starboard wing fueling boom, power driven conveyor belt, three hydraulic cargo lifts, a winch and gasoline engine, steel guide trench and positioning rig. There also are three carts to handle pre-loaded and pre-weighed outbound cargo.

In a series of recent try-outs, a DC-6B carrying a typical load of passengers, baggage and cargo, taxied to the end of the steel guide trench. The plane halted with its tail toward the mock-up. Ramp workers slipped the yoke of the positioning rig over the nose wheel and attached a direction-corrective arm under the port wing. The winch started up, drawing the plane tail-first into the Airdock.

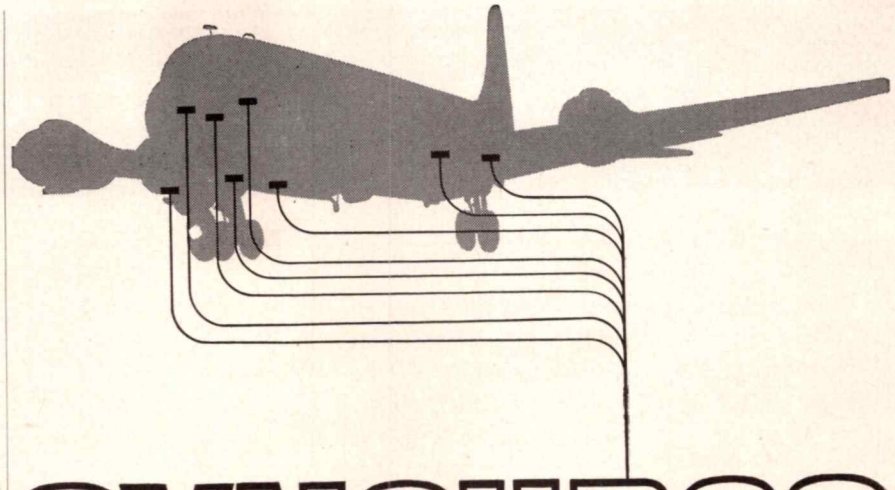
Passengers filed out on a bridge at the same level as the cabin door. Workers, meanwhile, began unloading baggage and cargo on a conveyor belt, running parallel to the starboard side of the fuselage. The belt is 140 ft. long, and travels at 120 feet per minute.

Control Working Area

The baggage and cargo flowed swiftly onto a revolving circular table in an area designated as the cargo work center. Workers removed baggage from the table for claiming by passengers as they walked down from the overhead bridge. A finished installation would have additional conveyors to carry away mail, express, freight and baggage from the sorting table.

The pits of the DC-6B were emptied in approximately four minutes. Outbound loading then began. Three carts, pre-loaded with baggage and cargo, moved out of the work center on the conveyor belt which now ran planewards. The first cart contained items for pits 1 and 2, the second held cargo for pit 3, the third for pit 4.

When the carts arrived below their specified pits, they automatically tripped off hydraulic lifts which rose to proper height under the control of cargo handlers. After the cargo was stowed and passengers boarded, the plane was quickly towed nose-first from the mock-up. END



SYNCHROS

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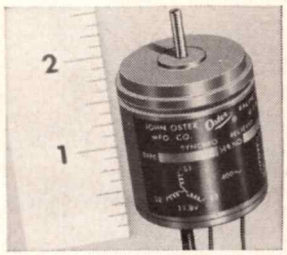

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THE TREND OF INVENTION

These patents appeared in recent issues of the U. S. Patent Office Official Gazette. Printed copies of the patent may be obtained free of charge on your company letterhead from Technical Editor, Aero Digest, 515 Madison Ave., New York 22, N. Y.

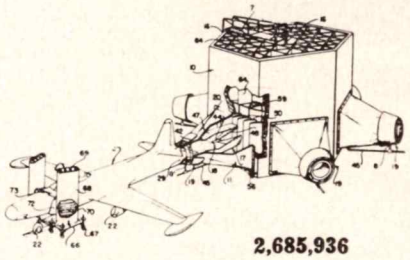
BH

fabricators for the aircraft industry

B. H. AIRCRAFT CO. INC.

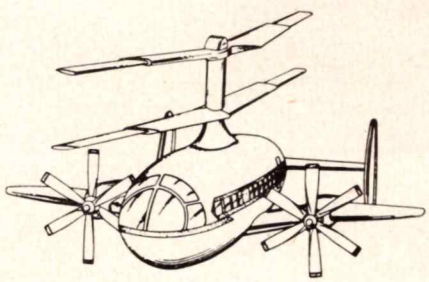
FARMINGDALE, NEW YORK

Sound reduction equipment for use with jet-propulsion units (2,685,936). R. W. Brenneman, E. Jacobson, and R. S. Jacobson, Hollywod, Calif., assignors to Lockheed Aircraft Corp.



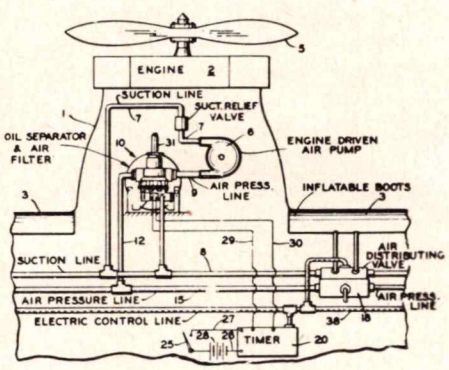
2,685,936

Rotary wing aircraft design (172,721). P. J. Papadakos, New York, N. Y., assignor to Gyrodyne Co., of Amer.



172,721

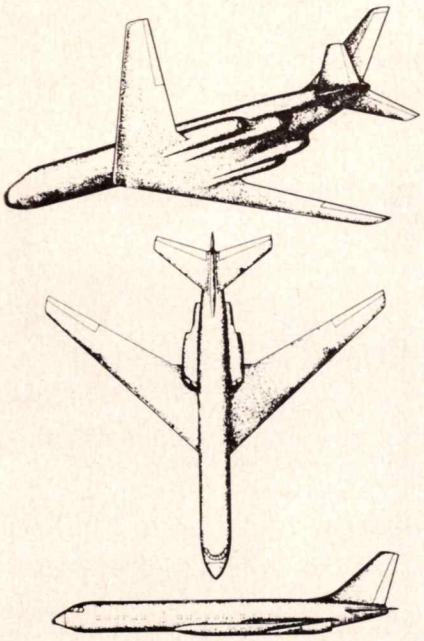
Control device for inflatable ice eliminating systems (2,684,818). A. A. Alexanderson, Hohokus, N. J., assignor to Bendix Aviation Corp.



2,684,818

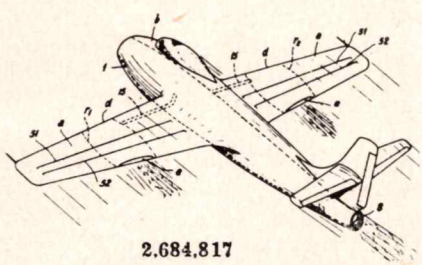
Airplane design (173,032). C. L. Johnson and W. M. Hawkins, Jr., No. Holly-

wood, Calif., assignors to Lockheed Aircraft Corp.



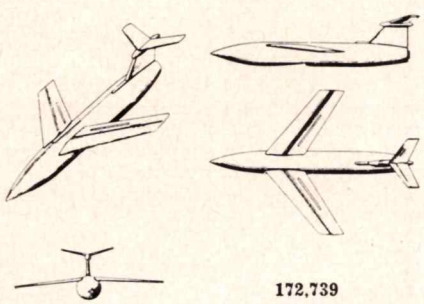
173,032

Aircraft powered by ramjet units (2,684,817). M. Roy, Paris, France, assignor to Societe Nationale d'Etude et de Construction de Moteurs d'Aviation.



2,684,817

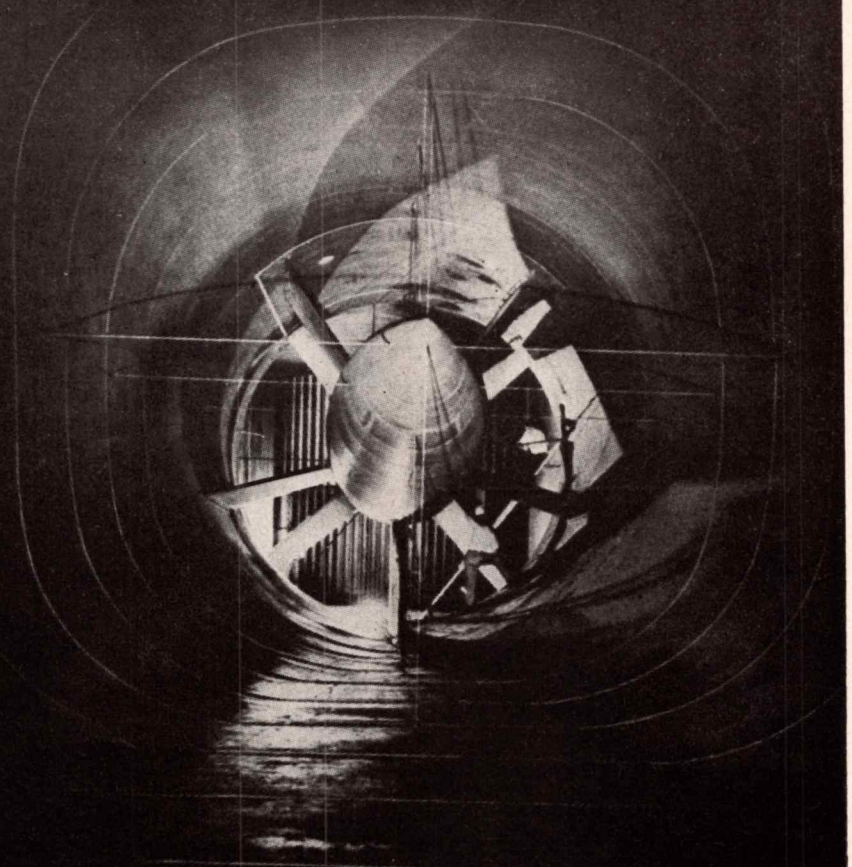
Guided missile design (172,739). W. J. Benckert and J. D. Bitner, Towson, Md., assignors to The Glenn L. Martin Co.



172,739

Two-stage fuel regulator for pulse jet engines (2,688,845). H. H. Ostroff, Fer-

How Much *Lift* In A Bootstrap?



In the competitive technical air-world of today, the answer is simply, "not enough." Ambition and ability are still key success factors but they must be implemented with the "tools of the trade" . . . wind tunnels, electronic computing devices, physical test and research laboratories. These modern facilities are necessary to probe all fields of airplane, helicopter, missile and propulsion development.

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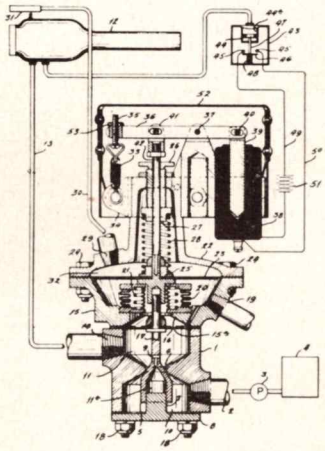
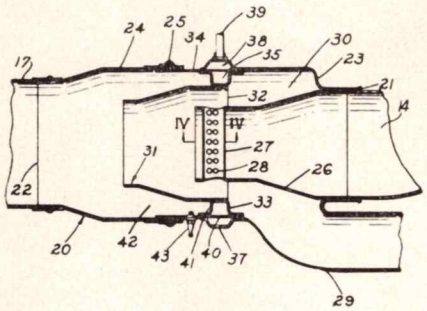


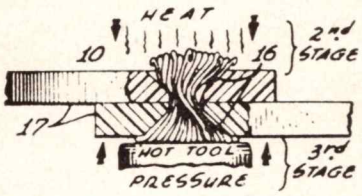
2,688,845

Apparatus for augmenting mass and velocity of exhaust streams (2,688,843). P. A. Pitt, San Diego, Calif., assignor to Solar Aircraft Co.



2,688,843

Prefabricated glass fiber rivet body (2,685,813). J. A. Lampman and H. E. Remillard, Anaheim, Calif., assignors to Northrop Aircraft, Inc.

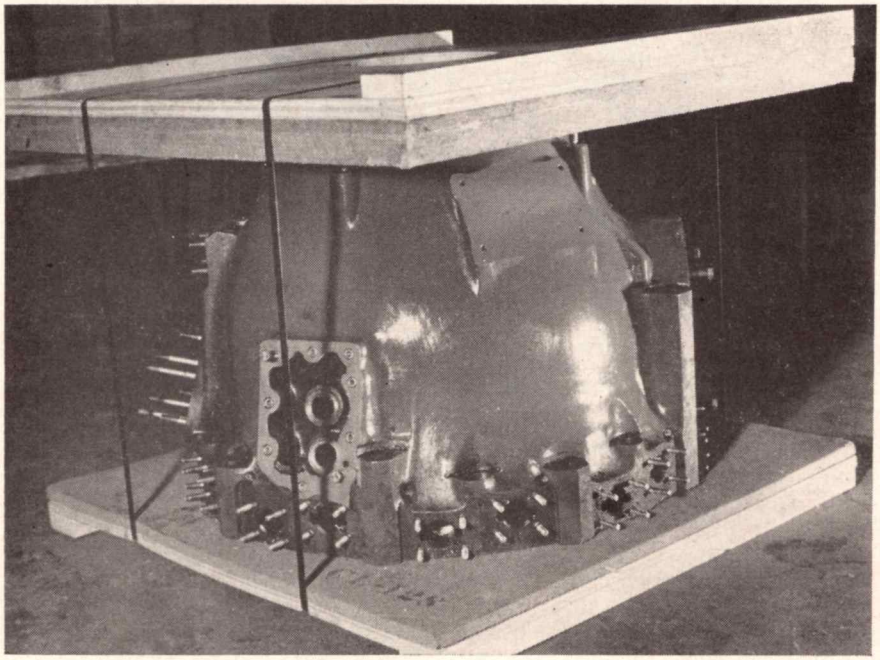


2,685,813

Wyle Research Corp., an independent research and testing organization (see Nov. AERO DIGEST), has developed a new electromagnetic vibration laboratory. The new facility was designed primarily for vibration analysis such as those included in Specification MIL-E-5272, and for the new missile environmental requirements.

Engine Parts Packing

Wright Aeronautical using new die-cut material for faster, safer packing



CLOSE to $120-million worth of aircraft engine parts have been shipped without damage by Wright Aeronautical using speed pack, a new packing material. Wright was the first to use the product for crating and transporting aircraft engine components.

Only three elements are needed: A reinforced corrugated container; a two-piece fibre pack; and steel strapping.

The packing material has chemically-treated laminated layers of industrial fibreboard to cushion the inside of the shipping container. The outside stays hard and with its acid coating protects the part from surface corrosion.

The pack is die-cut to fit the engine part and turned out on forms on a production-line basis.

In shipping cylinders, a square-bottom piece is die-cut with a circular cut-out in the center. This is placed in the bottom of the reinforced corrugated container. The cylinder is placed in the box, and the bottom of the barrel fitting into the round opening of the pack. Finally, the top piece, with its moulded cut-outs fitting the cylinder top snugly, is placed above it. END

By stencilling a "price tag" on all production equipment and tools in one of its divisions, Clark Equipment Co. found that production workers had more respect for their machines and tools. Men were more careful when they realized that a machine cost so much. As a result of this cost education program, Clark's tool breakage expenses have been reduced by 20 percent, and there has been substantially less machine downtime for maintenance and repair.

Development of a new type of thermocouple of rugged construction, used for measuring rapid temperature changes of metal wall surfaces, has been announced by the Engineering Div., Midwest Research Institute. The instrument is applicable for recording temperatures in aircraft skins. A plating of 1 micron (0.00004 in.) at the junction minimizes the response time of this instrument to temperature changes. Time required for the junction temperature to reach 63.2 percent of the amplitude of a stepchange of the exposed surface is about 1/4 microsecond.

AERO DIGEST
I Remember . . . .

POSTPONED PARCEL POST

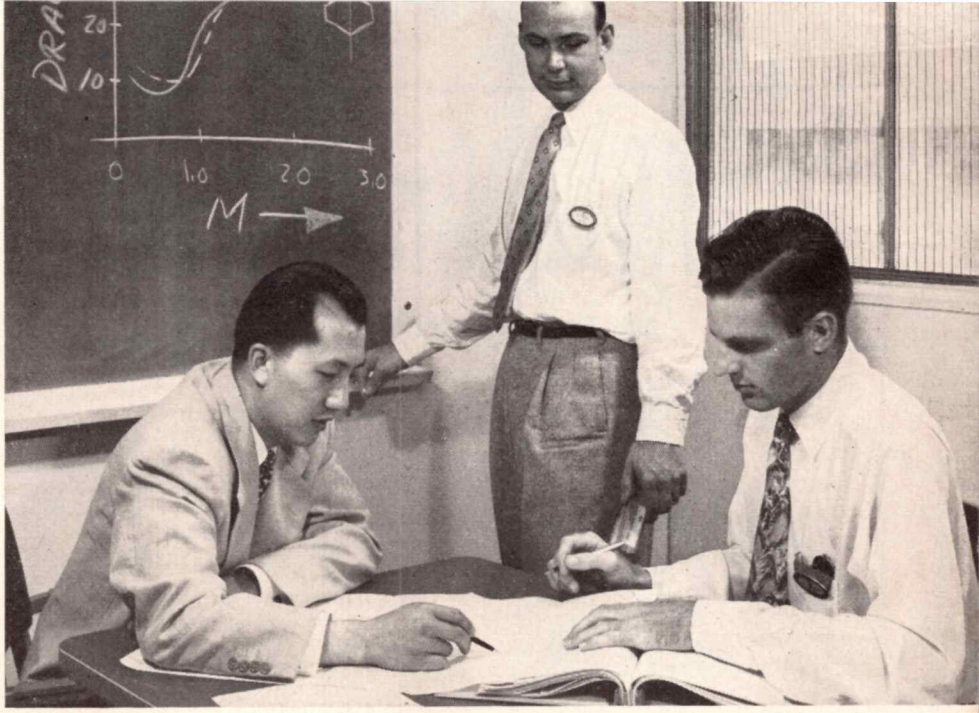
By HARRY M. JONES

Maine's first pilot. Aircraft Inspector, C.A.A. Member, Early Birds

I was sworn in as the first Parcel Post Air Mail carrier on Jan. 7th, 1913. My first trip started from Franklin Field, Boston, on Jan. 13 with stops scheduled for Providence, New London, New Haven, Bridgeport and New York. I followed the railroad tracks and each leg of the trip was to take about an hour. Winds and storms delayed my departure and the day I left I had to remove about half a ton of ice from the plane. I carried nine packages of Boston baked beans, weighing 25 lb. I landed on a baseball field in Providence where a delegation of four people met me.

Weather and engine trouble delayed my departure, and when I finally attempted to take off I cracked up. Repairs took about two weeks. I took off carrying more parcel post packages with Rhode Island johnny-cakes. I landed at night in New York with what was probably the first night air mail, for although authorized to carry only parcel post, I carried some letters in my pocket.

We got little encouragement for our efforts in pioneering in a new and hazardous field. When I cracked up in Providence, the N. Y. Tribune had this to say editorially: "The smashing of an aeroplane on which somebody was trying to carry mails from Providence to New London, suggests the inquiry whether actual United States mail matter is used in such performances, and, if so, on what ground the practice is to be justified. Letters are intrusted to the Post Office to be safely and expeditiously transported to their destinations, and not to be dropped into ditches or burned up by exploding gasoline or indefinitely delayed, for the sake of advertising somebody who aspires to moving picture fame."



Jim Hong, Aerodynamics Division head, discusses results of high speed wind tunnel research on drag of straight and delta wing plan forms with Richard Heppe, Aerodynamics Department head (standing), and Aerodynamicist Ronald Richmond (seated right).

Lockheed Expands Aerodynamics Staff

With five prototypes already in or near flight test, Lockheed's Aerodynamics Division is expanding its staff to handle greatly increased research and development on future aircraft in commercial and military fields.

The five prototypes, which show the breadth and versatility of Lockheed engineering, are: The XF-104 supersonic air superiority fighter; XFV-1 vertical rising fighter; C-130 U.S.A.F. turbo-prop cargo transport; R7V-2 U.S.N. turbo-prop Super Constellation transport; and an advanced jet trainer of the T-33 type.

New projects now in motion are even more diversified and offer career-minded Aerodynamics Engineers and Aerodynamicists unusual opportunity to: create supersonic inlet designs for flight at extremely high altitude; match human pilots with rapid oscillations of supersonic aircraft at low altitude; develop boundary layer control systems for safe take-off and landing of fighters and transports; remove aileron reversal and tail flutter problems incurred in high speed flight through analysis and design; participate in determining configurations of turbo-prop and jet transports and advanced fighters, interceptors and bombers.

To Aerodynamics men interested in those problems Lockheed offers:

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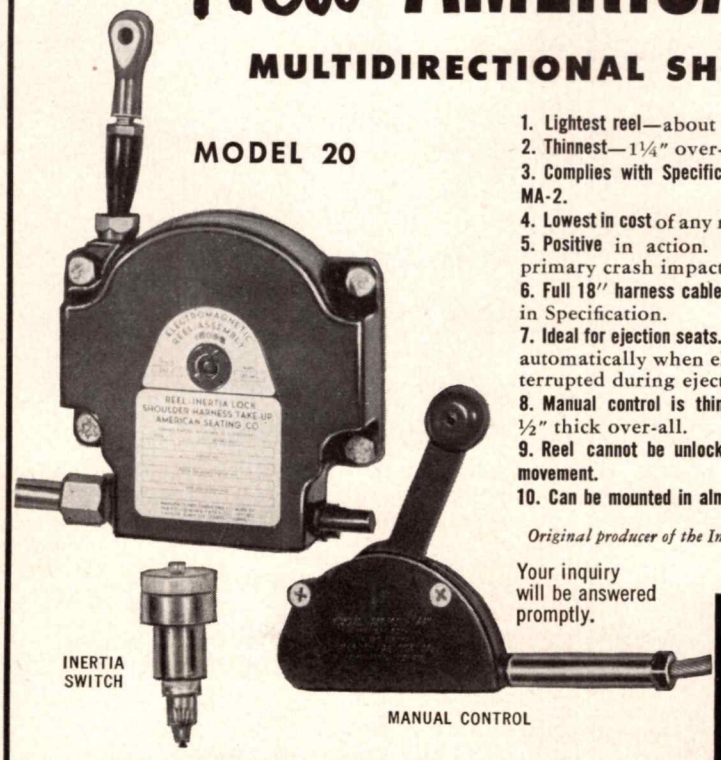

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Silencing A Jet Test Cell

New Ryan Aeronautical installation cuts sound intensities by one-half

RYAN'S new jet engine cell is hushed by the most advanced silencing equipment which acoustical science has devised. The new research tool will be used to test the nation's most powerful jet engines and afterburners.

Ryan is devoting $50,000 to the task of muffling the noise created by these powerplants under full power tests.

The silencing equipment will cut sound wave intensities to half initial strength in most of the objectionable frequency ranges. Due to psychological reasons, slight changes in sound wave intensities account for substantial variations in hearing sensation. This fifty percent reduction will actually mean that the noise heard outside the jet test cell will be only one 1/100th the amount which an unmuffled engine would create.

Stated another way, it means that employees immediately outside the test cell will be able to converse in normal tones when a jet engine is running with no more interference than would be caused by an unprotected turbojet operating four miles away.

In contrast to many industrial noises, jet engines produce intense noise levels over a broad range of frequencies.

Aeronautical silencers for jet engine test cells must be designed with aerodynamic and thermodynamic problems in mind, as well as to meet the acoustical requirements. For example, air inlet silencers must provide for a minimum of turbulence and pressure loss. Exhaust silencers must handle gases which reach 3200 deg. F.

Designed by plant engineers, the Ryan test cell is a monolithic concrete vault with three major openings. These are two towering air inlet stacks and an exhaust chamber, fed by a 7-ft. diameter tube. Since the two-foot thick walls of the cell conduct very little sound, the major sources of concern are the three openings. To muffle these, especially designed silencing equipment has been fabricated by the Industrial Sound Control Corporation of Hartford, Conn.

This equipment consists of assemblies of ICS's "Soundstream" units which are engineered to trap and absorb specific types of sound. Each unit is a perforated metal structure of sinusoidal configuration. They are filled with uniform layers of fibreglass material held in place with steel wire mesh. The units are installed in overlapping labyrinths designed to dissipate and absorb sound waves.

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I Remember . . . .

SPIRAL BOUND

By REAR ADMIRAL LUIS deFLOREZ, USNR

Learned to fly in 1912
Member, Early Birds.

During the first World War, I served with Jerome Hunsaker in the Bureau of Construction and Repair, Aviation Section, and had charge of the design, development, and production of aircraft instruments and accessories. This was an entirely new field, and when aircraft began to be used for definite missions and patrols, a lot of work had to be done to produce the instrumentation required.

In connection with testing instruments and devices to measure the acceleration of one of the Navy's early seaplanes, I rigged up a moving picture camera which I strapped on my chest. By sitting in the rear seat crowding back so I could get it in focus, and turning a crank, I could get a picture record of the instrument panel. While someone flew the ship, I would photograph the instruments during various maneuvers.

One day I drew a young Naval aviator who proceeded to wring the airplane out with the idea of seeing how much G he could produce. After a half-hour of hair raising routines, we went into a tight spiral which looked as though it would end below the waters of the Potomac.. The spiral continued and finally, after some desperate heaves on the dual controls, we pulled out just a few feet above the water.

As we landed the youngster turned around and yelled back "Do you think I did that on purpose? My boot got stuck in the rudder bar!"

The accelerometer broke, but I got the pictures.

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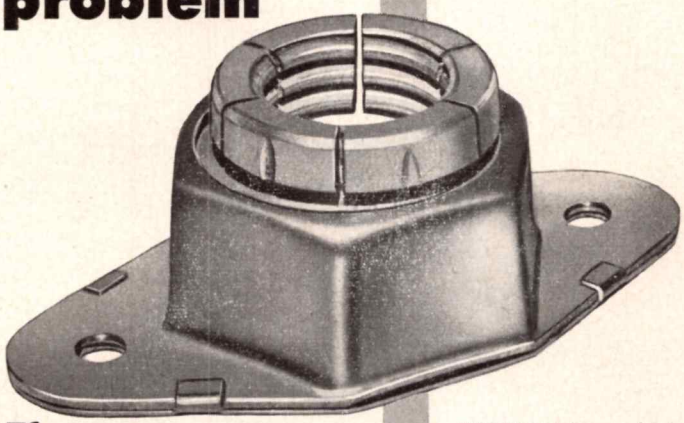

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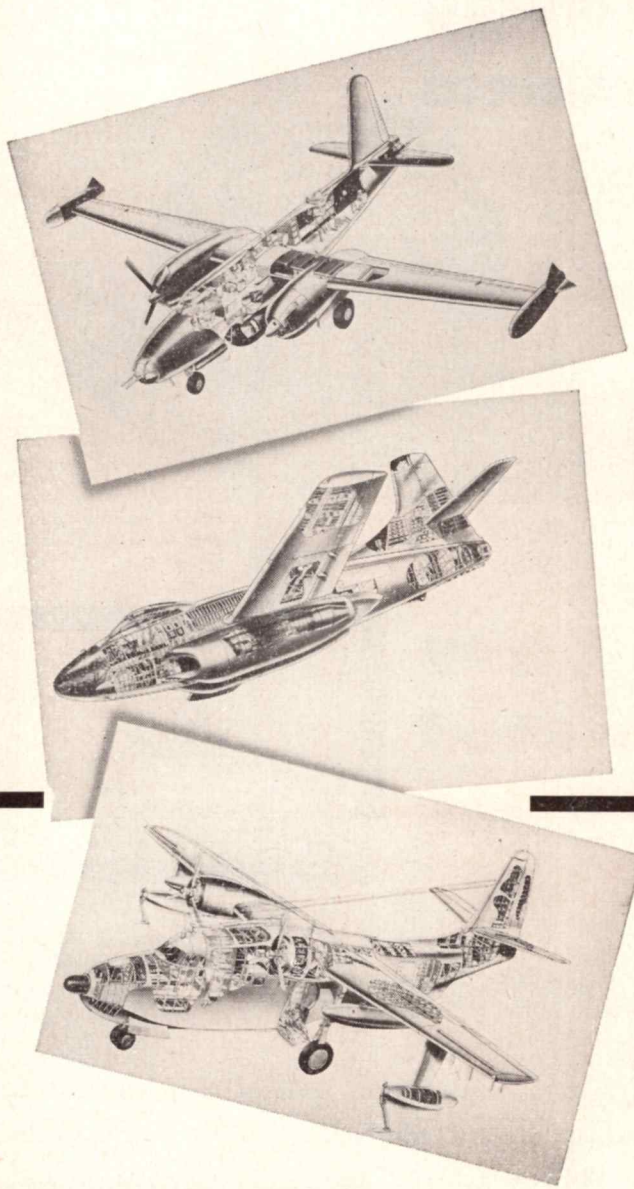

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A silencing system must be efficient in attenuating sound intensities in all of the frequency ranges where objectionable sounds are transmitted.

It is impossible to analyze sound without separating the subject into two parts; sound waves and the ear and brain which interpret them as sound.

Sound is a nice example of the propagation of energy by longitudinal wave forms. In air, sound travels at the rate of 762 mph or 1100 fps. When sound waves encounter a different medium, from that in which they are traveling, some of their energy is reflected, some is transmitted and the rest is absorbed in the form of heat. In this respect, sound waves act like light waves striking a glass panel where some of the light is reflected, some is transmitted and the balance is absorbed in the form of heat. When light strikes a completely black piece of velvet, all of the energy is absorbed. The objective of sound silencing systems is to absorb as much of the sound wave energy as possible within the costs

How to transform a truculent turtle into a mad bird was revealed the other day when the security curtain was lifted from the aft end of Lockheed Aircraft Corporation's P2V-7 Neptune. An early model of the P2V was the famous "Truculent Turtle," which made a world non-stop distance record of 11,236 miles. The latest version is called the MAD-bird—MAD standing for the magnetic airborne detector in its tail, a submarine-hunting device which appears here for the first time in a Navy production model.

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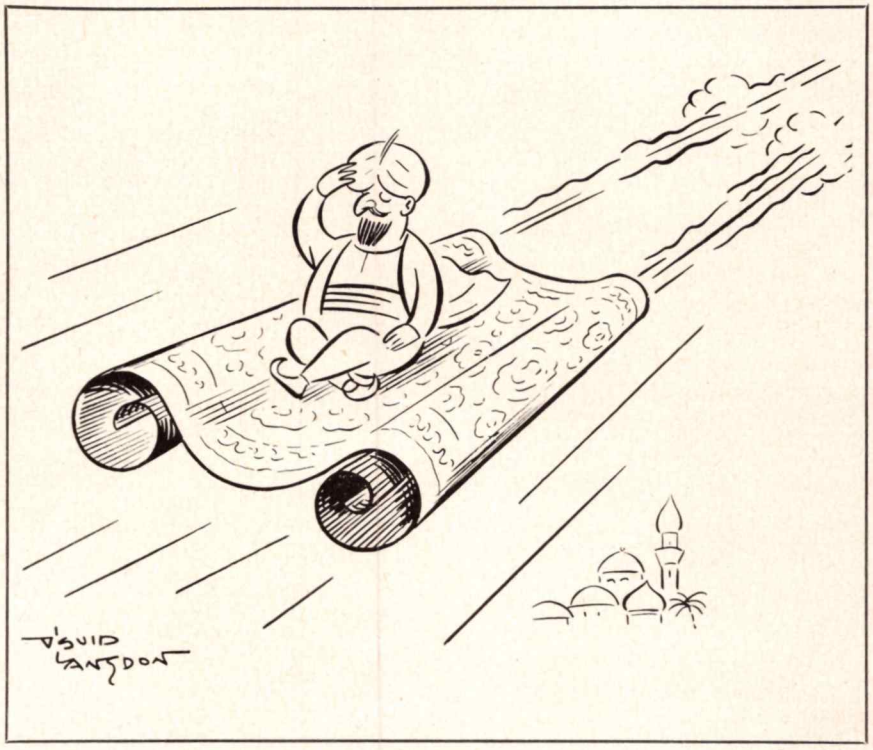
When sound waves strike the ear, they set the ear drum in vibration and part of the sound energy is converted into mechanical energy. The human ear can distinguish the pitch (determined by sound wave frequencies), loudness (determined by wave intensity) and tone (determined by the wave shapes) of sounds. The ear is sensitive to an enormous range of sound running from 20 to 20,000 vibrations per second in frequency and from a whisper to a thunderclap in loudness.

In the new Ryan jet engine test cell, Industrial Sound Control engineers have reduced the sound intensity of an operating jet engine from 150 decibels to approximately one half in most frequency ranges. At first glance, this might convey the impression that the noise heard outside the test cell would merely be cut in half. This is far from the case. An employee working outside the structure will experience only one 1/100th of the noise sensation which he would suffer if he were the same distance from the engine and no silencing were provided. To accomplish this, the silencing equipment must drain off more than 99 percent of the acoustic energy.

As a result, it will be possible for employees near the test cell to talk in normal tones and the general noise level will be about that prevailing in the average factory or machine shop. Without such silencing, the jet engine noise would create a sound intensity of 150 decibels which is more than simply too loud. This high noise level is beyond the listening level and within the area where pain or damage to the ear could be experienced. END



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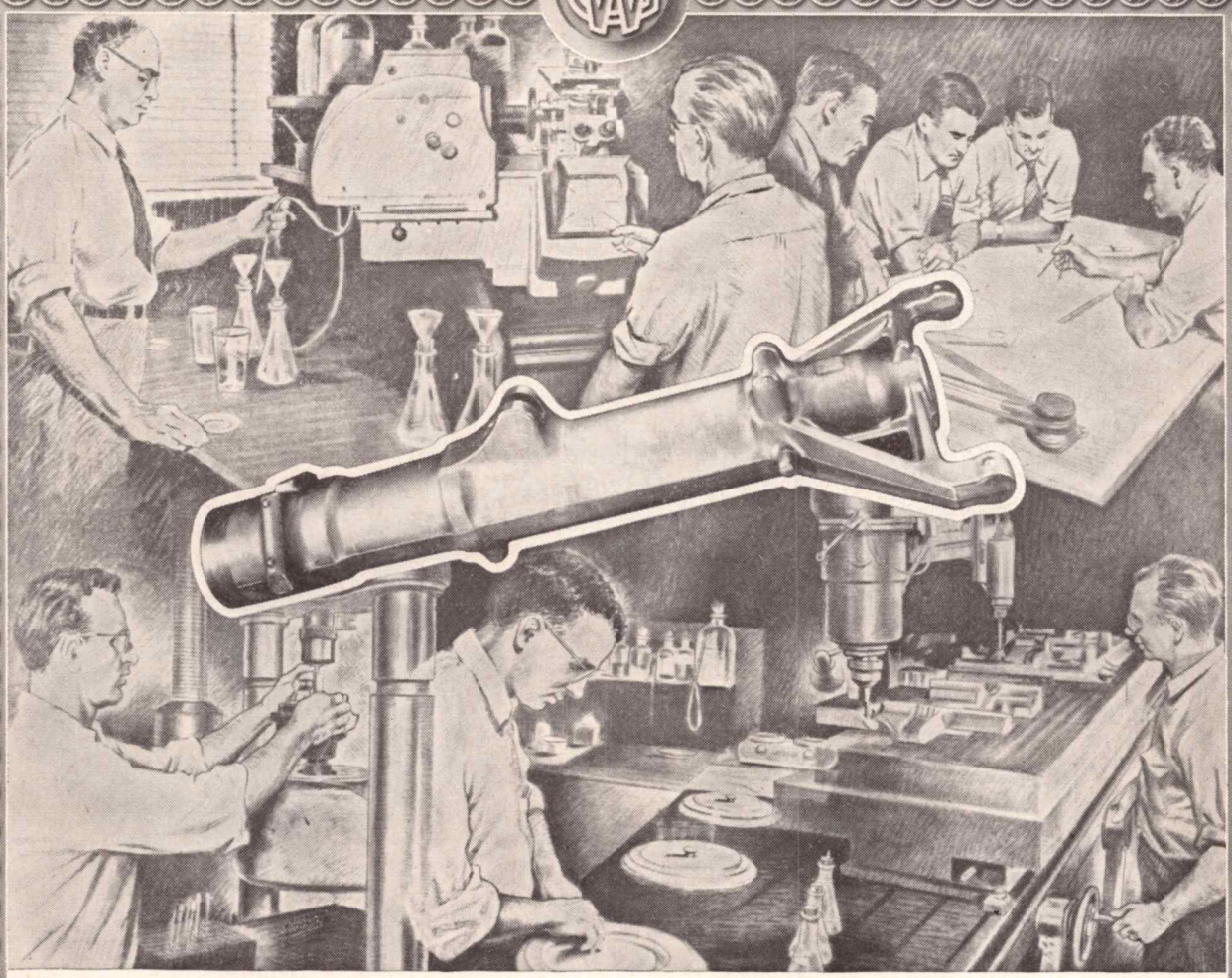

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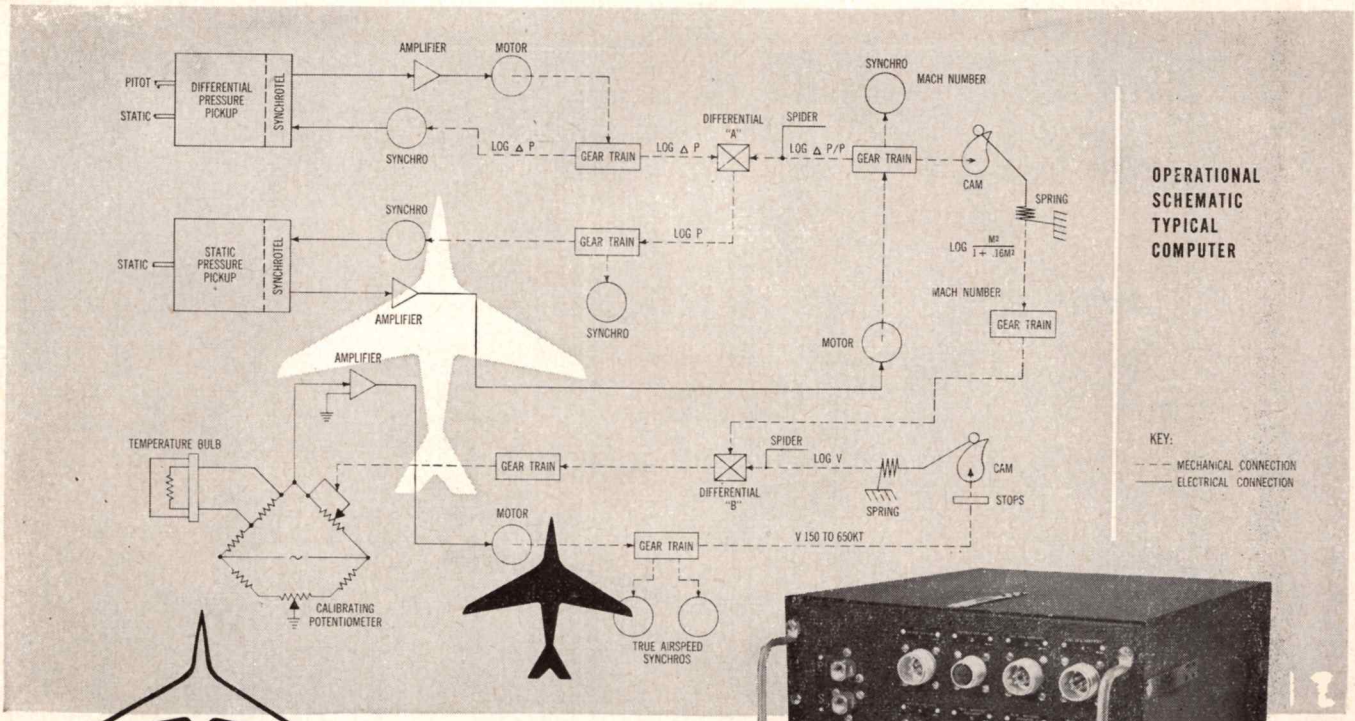

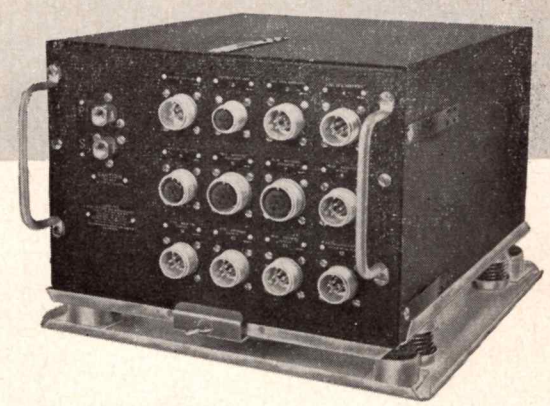

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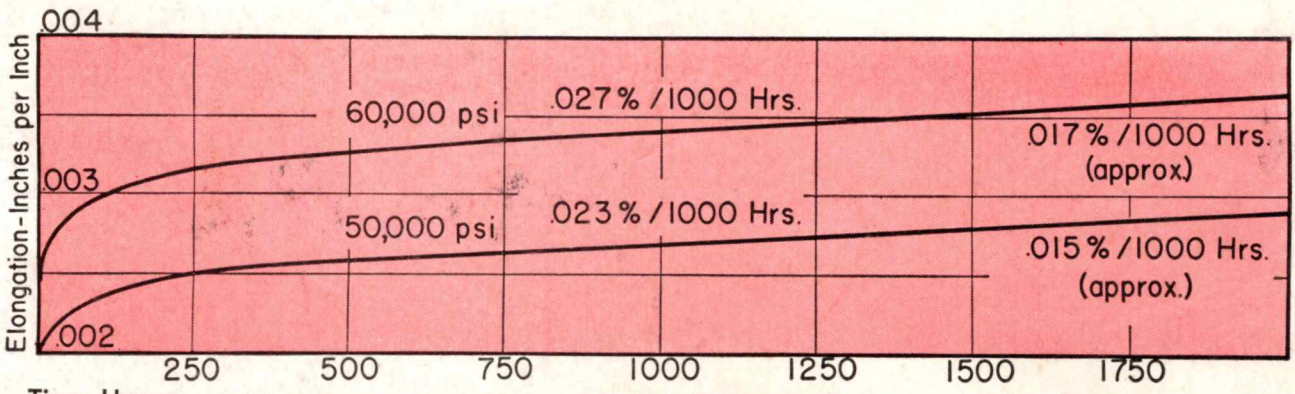
Contains less than 3% alloy

Gives maximum creep resistance to 1000°F.



Time-elongation creep curves at 900°F. show high creep resistance of "17-22-A" (S)

IF your gas turbine parts operate at temperatures not exceeding 1000°F., you can save critical alloys, yet get high alloy performance by using "17-22-A"(S) steel produced by the Timken Company.

"17-22-A"(S) steel contains less than 3% alloy. It permits you to cut costs. Developed by metallurgists of the Timken Company, "17-22-A"(S) has been used successfully for 10 years in refinery and steam power applications. The graph above shows its creep resistance at 900°F.

"17-22-A"(S) also resists heat checking and thermal cracking. It is readily workable up to 2300°F. It's easy to machine and weld. Maximum high temperature properties can be developed by normalizing and tempering, minimizing the possibility of distortion and quench cracking.

For complete information on "17-22-A"(S), and its companion analysis, "17-22-A"(V)—used at temperatures up to 1100°F.—write for Technical Bulletin Number 36A. And for help with your high temperature problem, call upon our Technical Staff. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

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